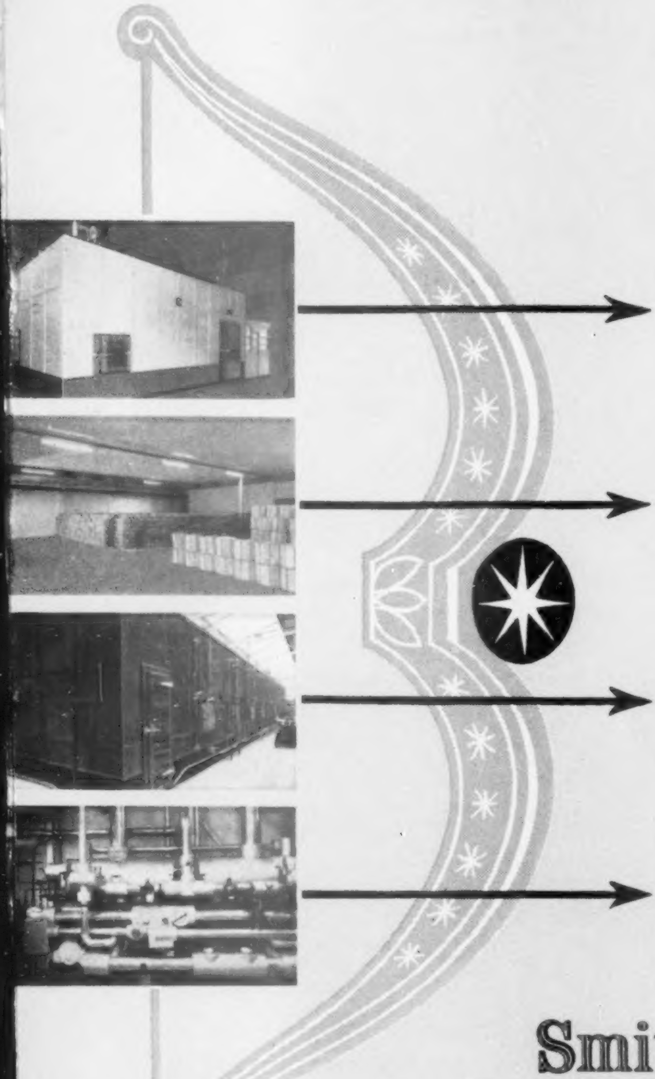
MODERN
REFRIGERATION
AND AIR CONTROL

Vol. 63 No. 745 APRIL, 1960 Price 2s. 6d. monthly



Lec
Super-Salesman G.S.91
Looks the goods...
Sells the goods!

- Integral slide-away night cover
- Front Rail Lighting
- Low Front
- Thermostatic Control
- Sealed Motor Compressor. Five Year Warrantee
- High-bake Enamel
- Full Length Impulse Buyer Shelf

Here is a Super Salesman in shining white and stainless steel, a constant invitation to every customer to buy from its fine display.

Study the specification, look at the capacity, you will see that the LEC sells on merit—a must for modern marketing.

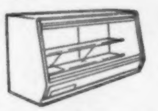
DIMENSIONS:
Length ... 72''
Width ... 30''
Height ... 41¼''

CAPACITY:
(Net) 10.7 cu. ft.
(Gross) 11.4 cu.ft.

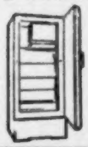
Price: £230.10.0 (includes £10.10 minimum installation and 12 months service fee).

G.S.D 71. Similar unit, but with 3 compartments. Capacity 7.1 cu. ft. Price: £149.10 (includes £7 minimum installation and 12 months service fee).

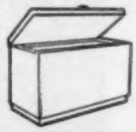
RC6 Refrigerated Counter £199.10 *



S13 Service Cab. £111 *

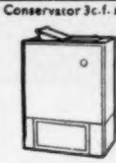


CF50 Conservator 12 c.f. £151.10 *



CD35 Dual Temp. Display £119 *

C9 Conservator 3c.f. £74 *



* Includes minimum installation and 12 months service fee.

The full range of our products can be seen at our London Showrooms.

217 REGENT STREET, W.1.
Tel. No. REG 6607.

**LEC REFRIGERATION LTD.
BOGNOR REGIS, SUSSEX.**

POST THIS COUPON TODAY

To: LEC REFRIGERATION LTD. BOGNOR REGIS · SUSSEX

Please send full details of the Lec Super Salesman, and other commercial cabinets.

NAME ....

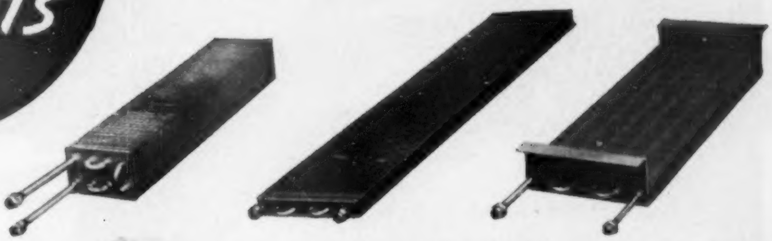
ADDRESS ....

....

M.R.18

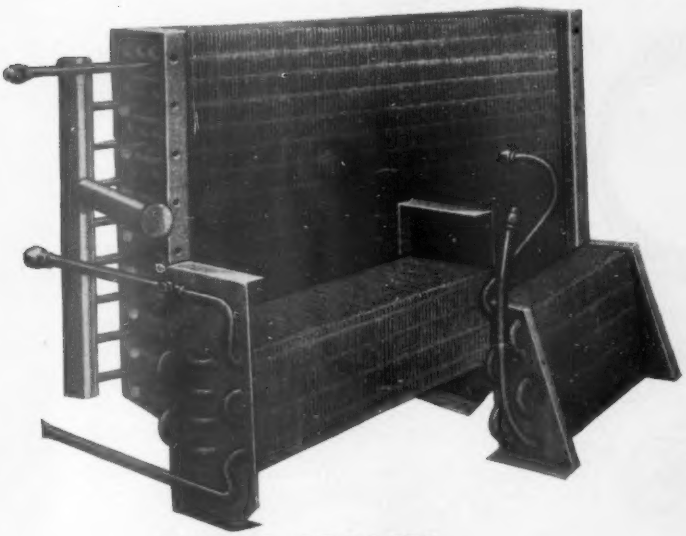
Use RA PRODUCTS

Manufacturers of Coolers and Condensers for Commercial, Industrial Refrigeration and Air-Conditioning Applications

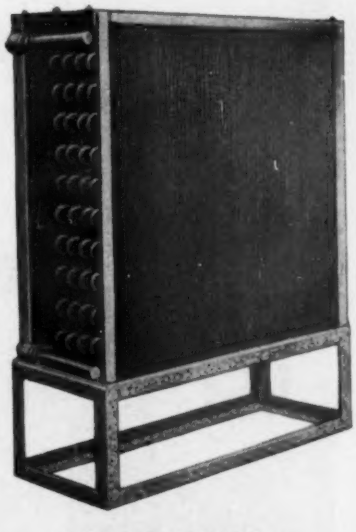


FINNED COOLERS

FOR :—DISPLAY CASE, COMMERCIAL and INDUSTRIAL APPLICATIONS



FINNED COOLERS
FOR AIR-CONDITIONING APPLICATIONS



FINNED TYPE
AIR COOLED CONDENSERS

REFRIGERATION APPLIANCES LIMITED

Head Office · 11-15 TUDOR ROAD · HACKNEY · LONDON · E.9

Telephone No. AMHerst 9747-8-9 Telegrams : CHILLYHACK, LONDON


Danfoss SOARS TO NEW HEIGHTS...
ROYAL NAVY
XJ474
. . . and are proud to announce their Expansion Valve is fitted by the de Havilland Propellers Ltd. in air conditioning equipment on the de Havilland Sea Vixen.
Danfoss Expansion Valves have been tested and are fully accepted by the Aircraft Industry.
Sole Agents for all Danfoss Refrigeration Controls :
DEAN & WOOD
(LONDON) LIMITED
17a-19 Artillery Row, Victoria St., London, S.W.1
Phone: Abbey 5841/3, Grams: Vulcanosum, London

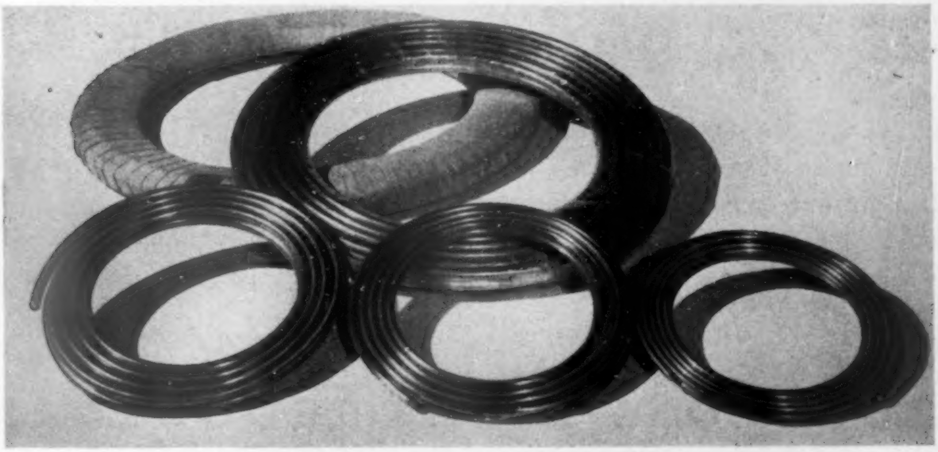
YORKSHIRE IMPERIAL

Refrigeration Tubes ensure a first-class product

When you order *Yorkshire Imperial* you are assured of high-quality refrigerator tubes with clean, smooth bores, dehydrated, and delivered in sealed coils of the correct temper. Unless otherwise specified, they are double-wrapped and will remain in first-class condition until you are ready to use them.

The tubing is coiled in double pancake coils in standard 20 ft., 50 ft. and 100 ft. lengths—or supplied in straight lengths—and when required can also be tinned on the outside.

Yorkshire Imperial also manufacture restrictor and bulb-and-capillary tubing—and a range of special "Yorkshire" Fittings for refrigeration work.



YORKSHIRE IMPERIAL METALS LIMITED

HEAD OFFICE—P.O. BOX 166, LEEDS   TELEPHONE: LEEDS 7—2222

ngineerin VISION

ost-saving

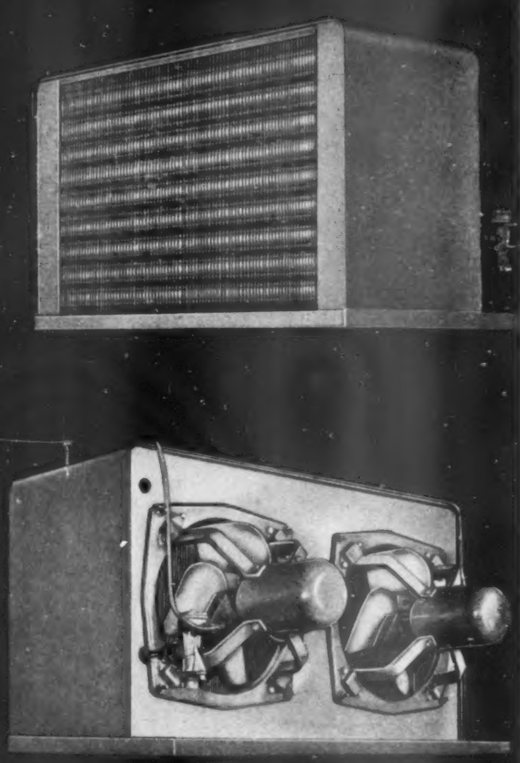
UCED

Lanc

UNIT TYPE COOLERS

For
Cold rooms
Air conditioning
Milk storage
Beer and wine cellars

Designed for continuous cooling at temperature ranges of 0° to 55°F—and soundly constructed from heavy gauge aluminium sheet chemically treated against corrosion—these Units have an attractive and hardwearing finish. With coil bank of tinned copper tubing expanded into light aluminium fins for maximum heat transfer—and available with or without Electric Defrost system—Lancastrian Unit Type Coolers are simple to install and economical to run.



LANCASTRIAN EVAPORATORS LIMITED

Send today for this Brochure.

The Greatest advance in Refrigerated Self Service Display!

NEW

Smithfrige-McCray

NEW
REFRIGERATION TECHNIQUE
Keeps food temptingly fresh, cuts operating costs

NEW
VISUAL APPEAL
Extra capacity ensures maximum stock on display
Full product visibility
Easy Shopping Angle

NEW
PRODUCE PERFECTION
Through precise temperature control with automatic defrosting

NEW
STYLING AND COLOUR SCHEMES
With warmed reach-in rail and ample storage room

The self service cases which anticipate the needs of tomorrow

Ask your Refrigeration Dealer or write direct for details

WRITE NOW for full Information

Smithfrige-McCray
KOLDFLO
SELF SERVICE CASES

AMERICAN DESIGNS

Made under licence by

SMITHFIELD REFRIGERATOR CO. LTD., 1 CROSS LANE, HIGH STREET, HORNSEY, LONDON, N3

there's a right temperature for everything...
A. Rh POSITIVE
... Blood — at the ready — temperature right.
Refrigeration Controls by Teddington — for blood — for everything — everywhere.
TEDDINGTON REFRIGERATION CONTROLS LTD.
Sunbury-on-Thames, Middlesex.
Branch Office & Trade Counters at:
31 Quay Street, Manchester. Tel: Blackfriars 2120
255 St. Vincent Street, Glasgow. Tel: Central 3933
London Stockists: H.R.P. Limited.
maintained by Teddington controls

. . . and splat again. Expected this. Old vacuum-forming machine. Not healthy. Might get worse! Could be in Paris. On the Orinoco. Or Putney. Wherever in the world trouble occurs you can have DANIELS service. Or a new machine. Quickly. Should you decide on a new Daniels machine, things will go smoothly — longer. Production higher. Quality higher.

Write immediately for Daniels "Splat-avoider" literature

World's finest, latest and fastest Vacuum-forming machines for the refrigeration industry. Range includes machines from 30" × 30" to 80" × 50" sheet capacity.

DANIELS OF STROUD

T. H. & J. Daniels Ltd. (M.R.) · Stroud · Gloucestershire England · Established 1840 · Tel : Stroud 661-664 Telex 43-43 Daniels Stroud England · Sole Agents in U.K. : Alfred Herbert Ltd. Coventry


BUY
BRITISH
BUY
SEARLE-BUSH
UNIT
COOLERS
96 STANDARD MODELS FROM 1,200 TO 270,000 BTU'S/HR

mobile refrigeration units

powered by

Lister

AIR COOLED DIESEL

Lister air-cooled diesel engines provide smooth running **reliable** power for all types of refrigeration plant, and because of their light weight and compact design are ideally suitable for mobile units. They can be provided with either electric starting or fully automatic control equipment.

The service of Lister specialist engineers is freely available for advice and consultation on request.

Please write to :

R. A. LISTER & CO. LTD.

Dursley, Gloucestershire. Phone: 2371. Telex: 43-230.
London Office: Imperial House, Kingsway, W.C.2.
Phone: TEMple Bar 9681.

INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION
INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION
INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION
INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION
INSULATION INSULATION

INSULATION *Taylors of Mitcham* INSULATION

INSULATION INSULATION

"OPINION"

"KNOTTY POINTS"

Why do you paint your woodwork in a Cold Store—is it to cover up rough and shoddy timbers ?

All paint transfers odour, and what a terrible problem you will have when you come to repaint quite soon, when all the stopping falls out and the paint peels off in sheets.

What to do—why, use rift-sawn clear timber and give it a 'Copal' carriage varnish finish and delight in its beauty—and forget maintenance.

Common sense, of course.

★

CONSULT OUR ADVISORY SERVICE

W. A. TAYLOR LTD

Head Office: **PITCAIRN ROAD, MITCHAM, SURREY, ENGLAND.**
Telephone: **MITCHAM 6161 (5 lines)**

Works: **CRUSOE ROAD and SWAINS ROAD, MITCHAM.**

Sales Office: **HOPE HOUSE, 45 GREAT PETER ST., WESTMINSTER, S.W.1**
Telephone: **VICTORIA 6444**

African Subsidiaries: **Overseas Insulations (Pty.) Ltd., JOHANNESBURG. Overseas Insulations (Rhodesia) Ltd., BULAWAYO, S. RHODESIA.**

INSULATION (×24, left margin)
INSULATION (×24, right margin)

INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION
INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION
INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION
INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION INSULATION

COOL, COOL WATER...

Keep out of hot water troubles and cut cooling costs by calling in VISCO. You can save 97% of your water bill by using a Visco Water Cooler. A size for every purpose. Consult THE VISCO ENGINEERING COMPANY LTD., STAFFORD ROAD, CROYDON. Telephone CROydon 4181.

VISCO STEELSHELL

Water Coolers

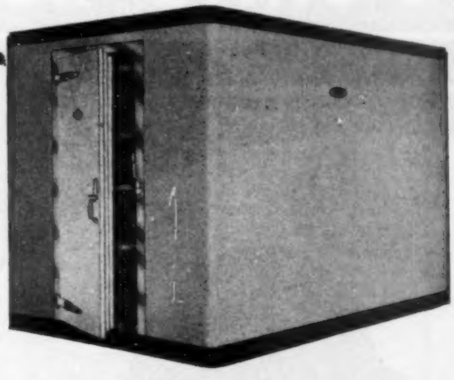
FWS

---

* *The* **economical method** *of* **MODERN STORAGE**

Whatever you pay for your refrigeration plant, it is so much money wasted unless it is absolutely reliable at all times.
FROZT-ED-AER equipment is both reliable and economical. There is a wide range of refrigerators for storage and display [or storage, display and deep freeze cabinets] at reasonable prices. Please write stating your business.

FROZT-ED-AER
Automatic
REFRIGERATION



500 cu. ft. Coldroom. All-white coach-built finish.

Applications for agencies invited.

FROZT - ED - AER, REFRIGERATORS
REDDISH STOCKPORT
(The Crowthorn Engineering Co. Ltd.)

Phone: STOckport 7271-2-3

Grams: "Crowtool," Reddish

CR. 353

CLASSIFIED ADVERTISEMENTS

Prepayment of Classified advertisements is requested. Replies to Box No. advertisements to be addressed to Box No.——, MODERN REFRIGERATION, Maclaren House, 131 Great Suffolk Street, London, S.E.1.

SITUATIONS VACANT

6d. per word. Minimum **12/6.** Box **2/-** extra.

APPLICATION ENGINEER for standard Frigidaire commercial products required for Brighton area. Write stating age, experience, present salary, etc., to D. P. Toomey & Co. Ltd., 67 Preston Street, Brighton. 1511

APPLICATIONS ENGINEER required with complete knowledge on Display Cabinets and general refrigeration principles. Excellent prospects and remuneration for right type. Birmingham organisation handling Self-Service refrigeration Display Cases.—Box 1515. 1515

ASSISTANT to Principal of York Distributors in East Anglia required. This is a unique opportunity for a man with wide experience of application work in connection with commercial refrigeration equipment up to 15 h.p. on refrigerant 12 and 22. The position offers wide scope for advancement for the right person who must be willing and capable of accepting responsibility. Salary commensurate with ability and experience. Write in first instance to Mr. A. S. Playle, Joint Managing Director, Playle of Maldon Ltd., Refrigeration Engineers, Witham, Essex, giving full details and experience which will be treated in confidence. 1460

COMMERCIAL Refrigeration Sales Supervisor. Vacancy exists in Frigidaire Distributorship for first class experienced Sales Supervisor to lead Sales Team in the Manchester area. Only men of approved record in this field need apply. Remuneration by way of good basic salary and generous commission. 1959 car will be provided. Assistance in removal could be arranged for the successful applicant, and fares will be paid for interviews. Applications in strictest confidence to J. H. Jones, General Sales Manager, F. W. Fidler & Son Ltd., Frigidaire House, Town Lane, Denton, Manchester. Telephone: Denton 4201. 1370

CHEMIST (Industrial)

Fully qualified. To work on own initiative at practical research and development. Experience essential on absorption type domestic refrigeration. Permanent salaried post with large company located Birmingham area. The appointment is pensionable and offers promotional opportunity. Write in confidence giving full information and commencing salary expected, to Box 1504.

DRAUGHTSMAN required with practical knowledge of lay-out for refrigeration Self-Service Display Cases. Excellent prospects and remuneration for right type of man.—Box 1516. 1516

DRAUGHTSMAN with refrigeration design experience required. This is a new appointment under a diversification scheme. West Birmingham area. Write in confidence in first instance to: John Evans & Company, Griffin House, 18-19 Ludgate Hill, Birmingham, 3. 1499

National Company of repute in the field of DOMESTIC ELECTRICAL APPLIANCES (Refrigerators and Washing Machines) requires a top-level

DIRECTOR OF SALES

This attractive appointment requires the services of a fully experienced man who has already achieved this status with one of the leading companies, though applications from National Sales Managers in the domestic electrical market will be favourably considered.

The successful applicant must possess drive, initiative, a good sense of leadership and thorough knowledge of sales promotion and distribution. He will be given every encouragement and the personal backing of the Managing Director, with whom he will work in close liaison.

Applications, which will be treated in strict confidence, are invited from executives aged 30-45 who are at present earning in excess of £2,000 per annum. Write giving full details of age, experience and career to date, to The Managing Director, Box 1517.

FIRST CLASS Service Engineer required preferably with York Shipley experience for operation in Devon and Cornwall. Good rates of pay. Pension Scheme, two bedroomed flat available. Applications in confidence to Arthur Brand Refrigeration Ltd., Mutley Plain, Plymouth. 1497

MAINTENANCE ENGINEER required for small Quick-Freezing Plant 12 miles Cambridge. Young man preferred. Please reply giving details of past experience, age, salary etc. to Box 1509. 1509

MSL *have been retained to advise on the appointment of an*

ASSISTANT
to the
TECHNICAL DIRECTOR

of a company manufacturing hermetic motor compressors and refrigerating systems.

The Assistant will be responsible to the Technical Director for managing the engineering department with a staff of 20. The department, which includes a drawing office and laboratory staff and electrical and process engineers, is carrying out a major programme covering the development and application of hermetic motor compressors and systems.

Candidates must be graduate engineers with experience of electro-mechanical appliances. Knowledge of low pressure refrigeration equipment would be an asset.

Preferred age 35 to 40 years. Initial salary in the range £1,500 to £2,000 with pension scheme and bonus. This post offers considerable scope for advancement.

Please send brief details in confidence, quoting reference TM2236, to J. G. Smith. In no circumstances will a candidate's identity be disclosed to our client unless he gives permission after a confidential interview at which he will be given full details of the appointment.

MANAGEMENT SELECTION LIMITED
212, West Regent Street, Glasgow, C.2
1503

REFRIGERATION ENGINEER: Chargehand required for Erection Department engaged on the Assembly and Testing of Packaged type Chilled Water Plant range 5 to 100 T.R. and associated equipment. Permanent position with good prospects and top salary for successful applicant. Apply in first instance for an interview to: Alfred Porter & Co., Ltd., Stella Works, Stanley Road, Teddington, Middlesex. Telephone: Teddington Lock 4406. 1510

REFRIGERATOR ENGINEERS with own premises required to give complete service to distributors of Commercial Refrigerators.—Box 1505. 1505

RESEARCH & Development Engineer required in an expanding laboratory. Applicants should have a degree or Higher National Certificate in mechanical engineering and be particularly interested in thermodynamics as applied to domestic refrigerators. A practical backgound in light engineering is desirable. This is an excellent opportunity for an engineer to have an interesting post with attractive working conditions and salary in a progressive Company. Applications in writing stating qualifications, experience, age etc. will be treated in confidence and should be addressed to Personnel Manager, Morphy Richards (Astral) Ltd., Industrial Estate, Dundee. 1508

REFRIGERATION Service and installation Engineers required for East Anglia. Applications from Engineers resident in East Anglia would be particularly welcome, although all applications will be given full consideration. Permanency and security to the right applicants. Good basic salary, commission, bonus and overtime. Superannuation applies. Cottage available for one engineer. Details in first instance, in confidence to Mr. A. S. Playle, Playle of Maldon Ltd., Refrigeration Engineers, Witham, Essex. 1461

REFRIGERATION Engineer, with not less than five years' experience; able to drive; sound knowledge of reciprocating units all types up to 5 h.p., and sealed unit mechanisms essential. Working knowledge of absorption principles an advantage but not essential; for progressive Sales/Service Organisation in London area. Apply in confidence to Box 1439. 1439

REFRIGERATION SALES MANAGER required by expanding London Company manufacturing modern refrigeration insulation. Seeks man with sound abilities of construction know-how. Well connected in the trade. Salary plus bonuses after qualification.—Box 1494. 1494

SERVICE and Installation Engineer Senior type, with modern Frigidaire experience required for rapidly expanding department. Modern house with garage available for man moving into area. Generous weekly wage and overtime, good opportunity for reliable man to settle in delightful area. Write in confidence giving fullest possible details of past and present employment and experience to Managing Director, Abbott Brothers (Western) Limited, Cattedown, Plymouth. Devonshire. 1506

SERVICE MANAGER: Company manufacturing Air Conditioning and Associated Equipment requires an experienced administrator to control the Refrigeration Installation and Service Department dealing in Industrial and Air Conditioning applications. This department operates from the South West London area. Top salary offered and excellent prospects with progressive Company. Apply in the first instance to Box 1513. 1513

SALES APPLICATION ENGINEER for industrial and commercial Refrigerating Plant and insulation. Must have previous experience of selling. Preferably willing to be based away from London. Apply with full details in writing to Sales Manager, Refrigeration Division, Wm. Douglas & Sons. (Engineering) Limited, Brewhouse Street, Putney, S.W.15 and mark personnel. 1518

VACANCY for Junior Draughtsman in Sales Engineering Department, Frigidaire distributor, Central London. Apply: Sales Manager, R. E. A. Bott (Wigmore St.) Ltd., 28 Wigmore Street, London, W.1. 1500

WHY not live and work on the English Riviera? Prestcold Distributors for Devon have vacancy for experienced Installation/Service Engineers in Torquay area. Good working conditions, non-contributory pension scheme. Permanent position for right men. Apply Service Manager, W. J. Allsop & Son Ltd., Refrigeration & General Engineering, Torwood Street, Torquay. 1520

YORK DISTRIBUTOR in Midlands area, require fully experienced commercial refrigeration service and installation engineer. Applications to John S. Hall Ltd., 12 Commerce Square, High Pavement, Nottingham. 1519

SITUATIONS WANTED

6d. per word. Minimum **12/6.** Box **2/-** extra.

FORMER CHIEF ENGINEER of U.S. air conditioning manufacturer now Professor of Engineering at University desires Summer employment outside U.S.A. Thoroughly familiar with all phases of equipment design, manufacture and service.—Box 1498. 1498

REFRIGERATION ENGINEER experienced all types of machinery requires position either at home or abroad.—Box 1502. 1502

ARTICLES FOR SALE (Secondhand)

6d. per word. Minimum **12/6.** Box **2/-** extra.

FIRST-CLASS equipment available for immediate delivery at reduced prices. One Wolseley Model A.O. Chilled Water Unit incorporating Coldrator Model IR324 ½ h.p. open type air cooled condensing unit. One Coldrator Model BS6H Beverage Cooler with sealed system. One B.TH. Model LA34 domestic refrigerator 3.4 cu. ft. capacity. One Coldrator Model CD3 3 cu. ft. table top domestic refrigerator 3 cu. ft. capacity. Five Plate Coils 50 cu. ft. capacity. Three Plate Coils 125 cu. ft. capacity. One Plate Coil 200 cu. ft. capacity. All reasonable offers considered. Enquirers interested please write in first instance to: The Electrical Equipment Co. (Leicester) Ltd., 106 London Road, Leicester. 1514

OFFERS are invited for freezing plant comprising Jackstone 'V' Froster Units, Prestcold Compressor, Cold Storage Cabinet, Hoist and ancillary tanks, recorders and baskets, either as complete plant or separate items. In good general condition, constructed in self-contained units. Appointments to view.—Box 1522. 1522

RECONDITIONED ammonia Compressors, 4" bore upwards. Selection second-hand, Condensers, Aircoolers, valves, piping etc. E. J. Fox, 29 St. Johns Road, Wallasey, Cheshire. Phone Wallasey 3474. 1521

SECTIONAL COLD ROOM 23′ × 31′ × 10′, 6″ cork insulation, double doors, for sale on site. Previously used for meat—loading 7 tons. Offers invited —Secretary, Palethorpes Limited, Tipton Staffs. 1501

REFRIGERATION COMPRESSORS

Several Compounds by J. & E. Hall and L. Sterne. Triple cyl. 10 in. x 8 in. Hall's 200 h.p. motor. Two York Shipley 10 in. x 10 in. with motors, and several 6 in. x 6 in. by Lightfoot and York. 5 in. x 5 in. Hall's, Lightfoot, G. & J. Weir. Several 4 in. x 4 in. York, Weir, Hall's and Sterne. 3 in. x 3 in. York complete motors and condensers. Lightfoot Freon VT7 and VT6 Compressors complete 10 h.p. and 7½ h.p. motors. Frigidaire 10 h.p. Freon Compressors and other leading makes from ¼ h.p. to 5 h.p. Large stock of Ammonia and Freon Coils and Sundry Refrigeration Equipment. Send in your enquiries ALFRED'S ICES (1954) LTD., 1-5, Hall Place, Church Street, London, W.2. Tel.: PADdington 6619/10. Grams: ICEFRIGO, London, W.2. 830

SECOND-HAND Ammonia refrigeration equipment suitable for 1,000 to 1,500 cu. ft. Cold Rooms, complete with coil evaporator, motor, fans, control gear, etc. Phone WATerloo 3355, Ext. 75 1512

UNUSED 200-ton Cold Room Equipment comprising coils, fans, 2 to 38 h.p. Condensing Units powered by two Lister Diesel Engines. Two sets double doors and six single doors—£2,200 per set ex works. Unused 100-ton Cold Room Equipment comprising: coils, fans, 2 to 26 h.p. Condensing Units powered by two Lister Diesel Engines. Two sets double doors and four single doors—£1,500 per set ex works. Unused 5 h.p. self-contained Refrigerating Units £90 each ex works. Apply Polarcold Ltd., Congleton, Cheshire. 1468

ARTICLES WANTED

6d. per word. Minimum **12/6. Box 2/- extra.**

MANUFACTURER required to supply domestic refrigerators suitable for marine use— 5 to 8 cu. ft. The unit housing should be capable of accommodating a unit 19″ × 17″ × 14″ high. Please supply full details to Box 1496. 1496

AGENCIES REPRESENTATIVES, ETC.

6d. per word. Minimum **12/6. Box 2/- extra.**

COMMERCIAL refrigeration salesman required with proved selling ability for Devon territory. Apply giving details to Exeter Refrigeration Co. Ltd., 40/41 New Bridge Street, Exeter Devon. 1493

ADVERTISER, resident Cornwall, experienced sales service commercial equipment all trades, Investigation, survey, experienced domestic retail trade. Seeks representation or agency. Bank/trade references.— Box 1507. 1507

SERVICE & REPAIRS

6d. per word. Minimum **12/6. Box 2/- extra.**

REPAIRS, overhauls and general maintenance effected for the trade. Specialists in absorption and Sealed Unit Mechanisms. Old cabinets modernised including restoving, rechroming, revitreousing, etc., as necessary. —The A.C.R.E. Company, 389, Green Lanes, London, N.4. MOU 0171/2. 836

MISCELLANEOUS

6d. per word. Minimum 12/6. Box 2/- extra.

"HOMEFREEZE" Ice-Lolly Packs for domestic refrigerators and other types of lolly moulds, sticks and compounds. Trade discounts, etc. from the manufacturer R. G. Harsant, 65, New Road, Ware, Herts. 1484

MANUFACTURER offers 16 cu. ft. cabinets to Distributors. Quantity production. With or without sealed unit.—Box 1495. 1495

MODERN REFRIGERATION

and Air Control News

Incorporating
COLD STORAGE AND PRODUCE REVIEW
and ICE AND COLD STORAGE

Established 1898

VOLUME 63 NUMBER 745

APRIL · 1960

Contents

Editorial	366
News of the Month	368
Hay's Wharf Extensions	369
The B.R.A. Luncheon	373
A Jacketed Cold Store	377
"Ideal Home" Review	379
Wall's Vast New Store	381
A New Cabinet for Blood Storage	382
Refrigeration in France	384
I.I.R. Meetings of Commissions	386
The Institute of Refrigeration Bulletin	388
Refrigerated Cabinets	392
Commercial and Industrial Section	395
Patents	403
Dry-Ice Production—II	404

Editor-in-Chief:
THEODORE A. RAYMOND

Advertisement Manager:
J. A. Hutchinson

REFRIGERATION PRESS LIMITED
MACLAREN HOUSE, 131 GT. SUFFOLK ST., LONDON, S.E.1
Telephone: HOP 5712 Telegrams: Buns, Souphone, London

Editorial . . . .

B.R.A.'s Successful " Annual "

U.S.A. Conventions

● The annual luncheon of The British Refrigeration Association set a new record in attendance, well over 600 members and guests making up a most vital assembly at the Connaught Rooms, London, last month. The good company was matched by the good fare and the B.R.A.'s director can be congratulated on having reached a " new high " in annual conventions.

● Chief guests were The Rt. Hon. Reginald Maudling, M.P., president of The Board of Trade, and Mr. J. R. Parratt, president of the National Association of Frozen Food Producers. Mr. John A. Howie, chairman of the Association, presided. In thanking the president of the Board of Trade for his kind references in toasting the Association, Mr. Howie replied in a sparkling speech which was as notable for its delivery and phraseology as for its stout defence of British makers of refrigerating plant. " I have realized recently that our Association is rather like a boxing club " declared the chairman. " In it, we enjoy the company of our fellow members, work hard to train ourselves and each other to the highest pitch of professional fitness which we can attain—and do our utmost to knock the living daylights out of each other, in our respective weights, whenever we get the chance. Since our last annual club meeting we have certainly had a most successful and interesting year. The lighter weights—lighter only in terms of size of equipment which they produce—have been outstandingly popular, especially with the feminine patrons; the middleweights have made a great impression on the supermarket clients; and, as for the heavyweights, almost everyone seems to be asking for their services.

● " Even the central offices of the political parties—according to information reaching me through devious channels "—went on Mr. Howie " have ordered specialized high-humidity gas-tight cold store which simulate the climate of Cloud Cuckoo Land, and in which they can keep their delicate principles, policies and pledges crisp and fresh from one election to the next. I understand that one of these parties recently opened its cold store because it had some misgivings about whether its ' Three Ps ' were still fashionable. It has now tacked a new bit on to the frayed edge of one of these garments and put it back into store—but it still has some doubts about the success of this operation."

● Mr. Howie then launched a recruiting drive with the words : " We are always happy to welcome suitably qualified new members. We have vacancies at all weights and we know there are some very promising novices whom we should like to have with us. There are also one or two good heavyweights who have so far gone solo, but have now come into the hands of new managers who might well advise them to join us. Our subscriptions are modest, but our training tough, so we think we could provide just the rejuvenation which they are looking for."

● Mr. J. R. Parratt is always respected for his forthright views. The cold storage industry recently entertained him and learned from him that storage rates were too high in this country. At last month's B.R.A. function Mr. Parratt again " waded in " and declared : " The other day a friend proudly showed me his new refrigerator (I think he paid full price for it too). There it was, a gleaming white giant—and I say giant advisedly, it was all of 4½ c.ft. I opened the door and there inside was a tiny inner door labelled ' freezer.' I happened to know from a recent report that the average temperature inside was well up in the 20's—I ask you gentlemen, ' freezer.' It might freeze water all right, it might even be suitable for brass monkeys, but what sort of an idea does it give the public ? I opened this little door and cuddled up in a nice warm corner was a frozen chicken. I could have sworn it gave me a dirty look, shivered and said, ' for heaven's sake, either close that door or give me my feathers back.' Many other manufacturers, I notice, skilfully evade the issue by merely putting their trade name on the frozen food compartment."

● After relating something of the enormous progress made by the frozen foods industry, Mr. Parratt declared : " It may be that the first stage of our rocket is beginning to tail off but have we perhaps a second stage which can now come in ? Let us look at what has happened. Quick-freezers have had immense help from makers of industrial refrigeration equipment and have been able to build up production and storage techniques the equal of anything in the world. But in the commercial refrigeration field they have had to battle against the virtual absence of suitable refrigeration in the home and until recently the virtual absence of shop display cabinets. Home refrigeration has been rather like the tortoise—not only up against a large number of competitive hares, such as TV sets, washing machines, vacuum cleaners, spin dryers, and the like, but also carrying in the race a very heavy penalty in the shape of purchase tax. Isn't it nice therefore to see the tortoise, having staggered over the brow of the hill, now scrambling along at a much more rapid pace ! Does the domestic refrigerator therefore constitute the second stage of the rocket which will carry quick-frozen foods to the heights ? "

● We learn from New York that the 67th annual meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. will be held in Vancouver, B.C., from June 13 to 15. The three-day programme will include four technical sessions on topics allied with absorption air-conditioning, refrigerants, thermoelectric effects

and heating. There will be three symposia covering domestic refrigerator engineering, commercial refrigeration and air-conditioning. The fora will, as usual, relate to immediate industry problems. Headquarters for the meeting will be at the Vancouver Hotel. The usual officer and committee meetings will precede and parallel other events. The latter will include the welcome luncheon on June 13th when incoming officers are installed, the annual banquet on June 14th, various trips to nearby points of interest and a special programme for the ladies.

● The 12th Exposition of the U.S. Air-Conditioning and Refrigeration Industry will be held in Los Angeles, California, on February 12 to 15, 1962, it was announced last month by the Air-Conditioning and Refrigeration Institute, sponsor of the industry trade show. In announcing the place and dates for the next ARI show, H. F. Spoehrer, chairman of the Institute's show policy committee, said: "Our decision to move the 1962 show to the west coast is in recognition of the tremendous population and industrial growth of that area, its increasing importance as a major market for the products of our industry, and a desire to make it possible for many people to attend the ARI show who have not found it convenient, or possible, to travel to Chicago or Atlantic City."

● With a process which could revolutionize the freezing industry in New Zealand and elsewhere, the Meat Industry Research Institute has made its debut in scientific circles by incorporating in its new laboratory building at Ruakura, Hamilton, two cold stores constructed on entirely new principles. The Institute's scientists consider that if the main construction design proves successful it will almost halve the erection and operation costs of freezing chambers in all types of industry. The new research building will cost £130,000. The sealing method employed in the first experimental cold chamber is a revolutionary type, incorporating the latest overseas developments, while in the second room, a sealing procedure which it is thought has not been tried overseas is being utilized. Insulation in a conventional cool store is obtained by applying to the interior of the building cork which has been dipped in bitumen. Not only an adhesive, the bitumen acts as a barrier to the infiltration of moisture-laden air from the exterior of the cold store. In the new method of cold chamber construction being tried at Ruakura the reverse of the normal procedure is being tried.

● A new and special issue of postage stamps is being made by the Danish Post Office to mark the opening of the first Danish Food Fair. The motif for the stamps is agricultural, and they have been designed by Rasmus Nelleman. The stamps will be first issued on April 28. The Danish Food Fair takes place in Aalborg between June 3 and June 12 and will be opened by H.R.H. Princess Margrethe, heir-apparent to the Danish throne. "M.R." 's representative will report upon this event in our July issue.

● We were reminded of some pre-refrigeration methods of cooling by the introductory section of Dr. Baumgartner's recent paper before the Institute of Refrigeration. One is elsewhere reminded of the existence of cooling devices long before the Middle Ages by Biblical verses such as "As the cold of snow in the time of harvest, so is a faithful messenger to them that send him; for he refresheth the soul of his masters" (Proverbs xxv. 13). The principle of evaporative cooling was utlised by the early Egyptians in fanning porous earthenware jars; in transport the porous nature of pigskins has been recorded from Biblical to quite recent times.

INTERNATIONAL CREDIT FINANCE

AT the end of last year the United Dominions Trust, Eastcheap, London, E.C.3, and several leading financial institutions in Western Europe formed an organization known as "The Amstel Club," which works on a system of bilateral agreements whereby a finance house in one country arranges on behalf of an exporter for an importer to receive medium-term credit finance in his own country. In recent weeks banking institutions in other countries have joined the club, which now has members in Austria, Belgium, France, Western Germany, Holland, Italy, Norway, Switzerland, the United Kingdom and the United States.

United Dominions Trust, as the United Kingdom member, has now issued a booklet which lists the member companies and describes in detail the procedure by which the required credit can be arranged. "The manufacturer is thus relieved," states the booklet, "of the task of either giving credit to his customer or seeking it on his behalf. No longer need he tie up capital which he needs for his own business or go to the trouble and expense of arranging credit facilities. These new arrangements enable him to sell for cash."

Numerous important transactions involving British exports to Europe are already under discussion with U.D.T's correspondent bankers in the countries concerned, and it is confidently expected that as the services of the Amstel Club become more widely known a considerable volume of business will result.

Mr. Douglas A. McGregor has been elected to the new position of comptroller for **Kelvinator International Corporation.** In his new position, Mr. McGregor will co-ordinate the accounting activities of foreign licensees and subsidiaries including Kelvinator, Ltd., of England; and Kelvinator of Canada, Ltd. He joined the company in 1938 and served in various positions including manager of the cost department in Detroit and plant comptroller. He was named divisional comptroller for Kelvinator in 1951. A graduate of the University of Detroit in 1933, McGregor is a director of the Detroit Chapter of the National Association of Accountants.

NEWS OF THE MONTH

Refrigeration and A-c Exports.—During February, 1960, air-conditioning and refrigerating machinery (commercial and industrial sizes) to the value of £764,060 weighing 1,160 tons, was exported from the United Kingdom. Comparable figures for February, 1959, were 893 tons, worth £584,766.

* * *

Exports' Analysis.—Of the 1,160 tons of air-conditioning and refrigerating plant worth £764,060 exported by Great Britain in February—quoted in the preceding paragraph—44 tons went to the Union of South Africa, 35 tons to India, 55 tons to Australia, 13 tons to New Zealand, 74 tons to Canada, 224 tons to "other Commonwealth countries," 36 tons to Eire, 13 tons to Sweden, 265 tons to Western Germany, 56 tons to the Netherlands, 111 tons to Belgium, 22 tons to France, 43 tons to Italy, and 169 tons to "other foreign countries."

* * *

Refrigeration Plant Classified.—Of the total exports of air-conditioning and refrigerating machinery during February, commercial refrigerators accounted for 326 tons, worth £185,094, industrial plant and equipment for 183 tons worth £80,782, and refrigerating machinery, equipment and parts including parts of commercial refrigerators, for 387 tons, worth £311,484.

* * *

Soft Fruit Marketing.—The vital importance of proper presentation of soft fruit in markets was the theme of the conference held recently, at Blairgowrie, sponsored by the Edinburgh and East of Scotland College. Mr. Hugh Smith, of the Ditton Laboratory, Kent, said that raspberries were a most difficult fruit to get to market in good condition. They had been active in studying precooling and transport. It was clear that a great many growers failed to appreciate the extent of deterioration between farm and market. Field heat must be extracted from fruits; and having extracted field heat, it was folly to send the fruit by open lorry or in a ventilated van. Some form of protected and insulated container service was needed.

* * *

Export of Small Refrigerators.—During February, 1,089 tons of complete refrigerators and domestic refrigeration equipment were sent overseas from Great Britain. These exports were worth £709,101. The 1,089 tons comprised 32 tons to the Union of South Africa, 13 tons to Rhodesia and Nyasaland, 5 tons to India, 31 tons to New Zealand, 572 tons to "other Commonwealth countries and Irish Republic," 73 tons to Sweden, 21 tons to Western Germany, 11 tons to the Netherlands, 1 ton to Belgium, 24 tons to Italy, and 306 tons to "other foreign countries."

* * *

B.R.A. Officers.—At the annual general meeting of the British Refrigeration Association, Mr. C. M. Marks (Hussmann British Refrigeration Ltd.) was elected chairman of the Association and Mr. N. F. T. Saunders (Kelvinator Ltd.) was elected vice-chairman.

SWEDISH TRIP—At the beginning of this month a visit was paid to the Mariestad factory of Elektro IWO, through the courtesy of this Swedish firm and their U.K. representatives, M. L. Winsor & Co. Ltd., of London. Mr. C. H. L. Darley of the latter firm was in charge of the party, which included British distributors and a member of the technical refrigeration press; the visitors travelled by charter plane from Southend (*full story next month*).

Hay's Wharf Add Extensive Capacity

New refrigerated space at Willson's Wharf totals 500,000 c.ft.

CONTINUING their policy of expanding their riverside accommodation for refrigerated produce, Hay's Wharf Limited have recently brought into use at Willson's Wharf a further block of six warehouses totalling 500,000 c.ft. These have been insulated for 10° F. on five floors and this addition raises the firm's Thames-side capacity to over six million cubic feet.

The converted warehouse buildings are approximately 80 years old and have solid brick load-bearing walls with timber floors supported on timber beams and cast iron columns, and timber roof trusses with purlins and slate covering.

The insulation decided upon is in the form of a complete envelope embracing the six buildings and, in order to achieve continuity of insulation, it was necessary to trim and cut back the floor edges using rolled steel joist trimmers supported on the brick walls and insulated to prevent heat losses.

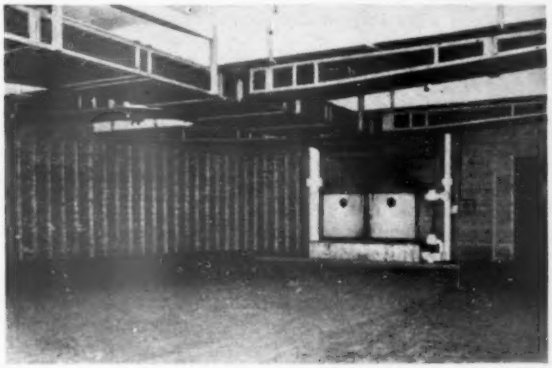
Insulation to the lower side of the first floor is attached to a suspended ceiling so arranged that any deflection of the floor construction would not affect the insulation.

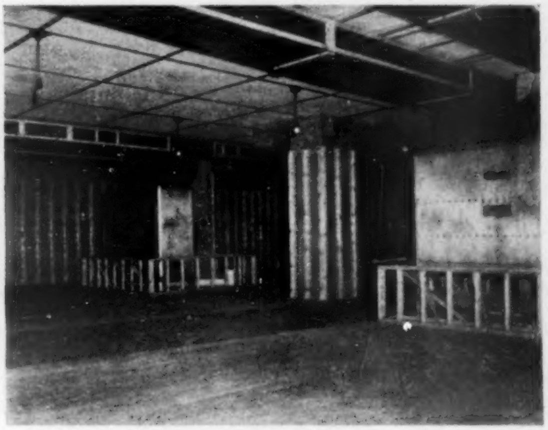
The old roof was examined with a view to insulating under the roof spaces, but the roof construction was such that this proved impracticable. It was, therefore, decided to remove completely all the roof construction and replace by flat concrete roofs supported on clear span steel members.

Before insulating the walls, the wall surfaces were rendered and a vapour seal applied. Vapour seal was also applied to the underside of the ground floor ceiling and to the topside of the insulation which is attached to the flat roof.

Cast iron columns on the 1st, 2nd, 3rd and 4th floors were insulated continuously to avoid heat losses and also as a prevention against possible frost-heave at the bases of the ground floor columns.

A new bridge structure to serve all floors connects to the new delivery lifts, and insulated doors onto





Above: A typical 10°F. chamber. Right: One of the sub-zero chambers.

these bridges are protected externally by sheet steel to meet the fire requirements of the London County Council. This also applies to the insulated doors to other bridges leading from adjacent warehouses.

The two delivery lifts serve all floors and a loading bank, which is covered and has standing space for five lorries.

Sub-Zero Store

Additionally, a modern, steel-framed building, which houses the engine room on the first floor, has had its four upper floors comprising 76,000 c.ft. converted

Butter in store in a 10° F. chamber.

to a sub-zero store to provide a temperature of $-20°$ F. This is also insulated with a complete envelope in similar fashion to the old buildings and, in addition, all the internal cased steelwork has been insulated.

The conversion work described above was carried out by Hay's Wharf's own staff under the supervision of Mr. W. E. Hogben, M.I.STRUCT.E., the company's surveyor.

Insulation

All the chambers are insulated with Onazote. In the main store the walls have 4 in. applied to the brickwork previously treated, a vapour seal of Kingsnorth 25 and $\frac{3}{4}$ in. rendering. Two-inch battens faced with $\frac{3}{4}$ in. T and G protect the insulation on the chamber side. The ceiling of the topmost chamber has 5 in. of Onazote suspended from the concrete ceiling while the lowest chamber has 5 in. insulation applied to the underside of a false ceiling suspended under the 1st floor. The insulation forms an almost unbroken envelope. Insulated doors contain 4 in. of Onazote.

The insulation in the sub-zero store is similar in application and finish but there is 6 in. on the walls and 7 in. on the ceiling of the topmost chamber and on the floor of the lower-most chamber.

All cold brine piping is insulated with 3 in. of Onazote finished with 1 layer of linentape, while all warm brine piping is insulated with 3 in. of felt finished with canvas. Ammonia and suction and liquid lines are insulated with 3 in. Onazote in two layers, finished with linentape. The evaporators are fitted with 5 in. of Onazote in two layers arranged so that the end caps can be removed. The external condensing water piping on the roof is insulated with 1 in. of Onazote finished plastic bitumen. The water cooling pond is insulated with 2 in. of Onazote and has in addition an automatic heating coil immersed in the water.

In order to minimize the effect of open cold store doors, Miniveils are fitted to the openings onto the bridges. They are not fitted to doors used only for escape purposes. The entrances to the store from the lifts are all equipped with frost mats.

Chamber cooling is effected by air circulated over cold brine coils in the case of the 10° F. warehouses and over direct expansion "Freon" coils in the case of the $-20°$ F. chambers. In the latter there are 2 air coolers per floor while in the first-mentioned building there is only one per floor.

The ammonia and "Freon" compressors, the switchboards, the brine and water pumps, the brine coolers and all condensers are situated in the engine room on the first floor. Condensing water is obtained from an induced draught water cooler situated on the roof of the building.

Electricity is obtained from a special 11,000 v. sub-station on the ground floor while the boiler room is under the office block.

The store is on Lloyd's Register and has the normal standby capacity. The whole plant is entirely automatic.

The covered delivery and despatch bay.

The existing goods handling equipment has been augmented by two 2-ton high speed electric lifts.

Automatic Control

The cold brine storage tanks are maintained at a temperature appropriate to the chamber temperature, being maintained independently of the demands of the cold chambers. This means that although the fans cannot be run while men are working in the chambers, refrigeration of the brine can continue automatically 24 hours each day, except only when considerations of electricity maximum demand penalties during the winter months render it uneconomical to do so, or when defrosting is taking place.

The very comprehensive control panel and attendant switchgear.

Cold Air

In the main store cooling is by forced air circulation over brine cooled air coolers, one to each chamber, through ceiling ducts discharging through ports. The brine passes through stacks of steel pipes gilled at ½ in. spacing with rectangular fins each containing two cold brine pipes with a third pipe ½ in. diameter passing between the other two. This third pipe carries warm brine for defrosting purposes in an independent closed circuit.

The warm brine is heated in three calorifiers, the hot water for which is provided by two oil-fired hot water boilers located in the basement under the offices where they adjoin the central heating plant but are entirely independently operated from the automatic control panel in the engine room.

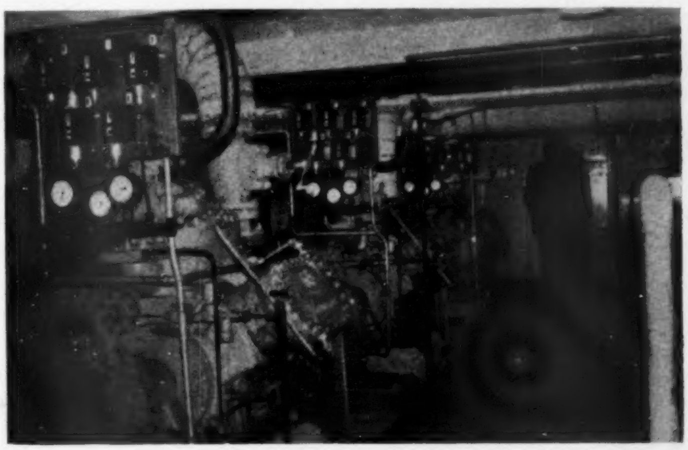
The cooler trays are insulated and electrically heated whilst defrosting is taking place, the water being discharged to the main drainage system via insulated and electrically heated pipes.

The sub-zero store is also cooled by forced air circulation passing over direct expansion "Freon" air coolers, two in each chamber. The air passes through stacks of tinned copper tubing over aluminium fins at ½ in. spacing. Defrosting is carried out by " Frost Master " system which uses an electric heating cable running in contact with each tube.

In both stores automatic temperature control is obtained by two thermostats in each chamber. These actuate relays in the control panel which start up the appropriate fans and brine pumps. They also illuminate pilot lights on the panel to indicate when refrigeration is being called for.

Cold Brine

Brine is cooled by two evaporators situated in the engine room. They are of shell and tube construction 34 in. dia. × 16 ft. long, welded, with gas dome and



The compressors and auxiliary plant for the ammonia system.

multipass endcovers. Each evaporator has a surface of 1,500 sq.ft. and contains 288 tubes 10g × 1¼ in. o.d. There are six brine passes resulting in a brine pressure drop within the cooler of 6½ lb. per sq. in. Both evaporators are used in parallel.

Six thousand gallons of brine are stored in three tanks on the roof being connected to the bottom of the evaporators through two interconnected 6-in. pipes. From the top of the evaporators a header connects into the suction of eight brine pumps, one for each of the six sections and two standbys. Separate 3½ in. deliveries from these pumps circulate brine through the floors coolers and then through open deliveries to the roof tanks.

The pumps are Stothert & Pitt single-stage, centrifugal type, directly connected to 10 h.p. motors running at 2,900 r.p.m. each circulating 9,600 gallons of brine an hour against 80 ft. total head. Pump starters are incorporated in the switchboard.

All pumps including the two spares have "auto-off-hand" switches and changeover "normal-standby" switches on the switchboard. Tanks and pumps are insulated.

Automatic operation for brine cooling is obtained by means of three thermostats placed in the cold brine roof tanks; these are set to slightly different temperatures and bring in one, two or three compressors as necessary.

These thermostats work in conjunction with the brine pump starters and the circuit is so arranged that should brine require refrigeration when air coolers are not called for, a brine pump will automatically start.

The evaporators, pumps and brine piping in the engine room are under a constant static head of about 50 lb. per sq. in.

A brine makeup tank is provided in the engine room having a 1½ in. water service, a separate connexion being provided for the cold and hot brine circuits. The brine from either of the two systems can be withdrawn into the makeup tank if desired. Discharge from the makeup tank into the brine systems is through a "Mono" pump, delivery 1,500 gallons per hour against 100 lb. per sq. in. maximum when running direct connected to a 5 h.p. × 960 r.p.m. electric motor.

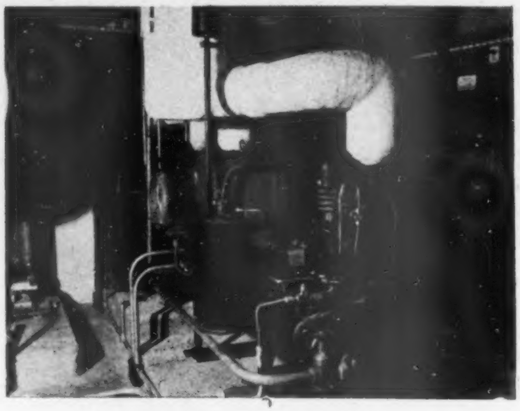
The Ammonia Refrigeration Plant

Ammonia is withdrawn from two evaporators by three compressors through a single 8 in. pipe. The fourth compressor is a standby.

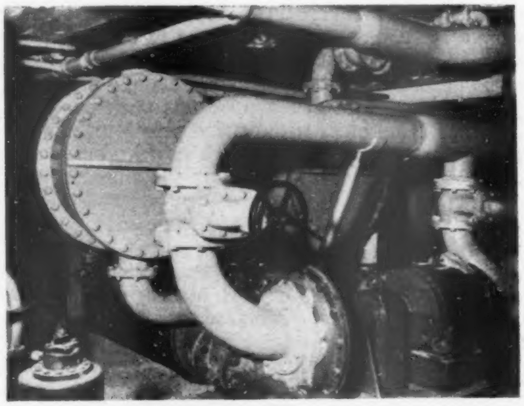
The compressors are of Lightfoot manufacture and are enclosed semi-vertical, single-acting, six-cylinder type A56, the cylinders being 5¾ in. bore × 5¼ in. stroke; at 700 r.p.m., the three together are capable of producing 120 TR when operating at a suction temperature of −8° F. and condensing at +95° F., these being the correct operating conditions for the plant when maintaining a chamber temperature of +10° F.

Because the store is designed to operate also at higher temperatures, special precautions are necessary to deal with the increased refrigeration then available.

The compressors are driven by vee-belts from General Electric motors developing 140 h.p. when running at 1,450 r.p.m.



"Freon" plant in the main engine room.



Shell-and-tube condenser with water pump.

Automatic Selection

Each compressor is fitted with a hand-off-auto switch and there is also a sequence selector switch enabling the machines to be called into service in any order, thus ensuring equal use; a further selector switch enables the standby machine to be selected from any of the four compressors.

Automatic liquid injection is provided and there is also a special high temperature cutout in the delivery line to shut down the machine should the discharge temperature approach the breakdown point of the lubricating oil.

The plant has been designed to run at a suction temperature of −8° F. when maintaining rooms at 10° F. and under these conditions an average brine temperature of −1½° F. is expected with air in and

(Continued on p. 400)

"Look to your Exports"

—B.O.T. PRESIDENT

"RELATIONS between the refrigeration industry and the Board of Trade have always been pleasant," said Mr. Reginald Maudling, President of the Board of Trade, when he proposed the health of the British Refrigeration Association at its annual luncheon held at the Connaught Rooms, Kingsway, London, on March 25. The response to this toast was delivered by Mr. J. A. Howie, Chairman of the Association, who also welcomed the guests, and the response on behalf of the guests was given by Mr. J. R. Parratt, President of the National Association of Frozen Food Producers.

In the course of his address, Mr. Maudling said he was happy to see that despite its many problems the industry had expanded, and in fact, its expansion had been one of the most remarkable since the war. Steel was one of their worries, he said, and he hoped that easier conditions would soon change this. The expansion of the domestic side of the industry had been astonishing, but he had been surprised to learn that houses with refrigerators were still a very low percentage. There was, he thought, a big market here.

Advances in commercial refrigeration were making a big contribution to the nation's welfare; there were now many food lockers all over the country and with the advent of refrigerated display cabinets standards of food were higher.

The new industrial uses being exploited were interesting and encouraging. The contribution which refrigeration had made to the processing and distribution of foodstuffs had been considerable and their aims of ensuring that goods were presented in their best and most attractive condition were commendable.

The future opportunities for the refrigeration industry were many, particularly abroad. With improvements in living conditions in many countries with warm climates, the export prospects for their equipment were good and he hoped they would make an effort to get abroad. Over the last 12 years exports of industrial and commercial refrigeration equipment had increased considerably. In 1957/59 production of domestic refrigerators had doubled, but he was disappointed to know that exports in this field had not increased. He hoped to see an expansion here.

Thanking the Minister in his reply, Mr. J. A. Howie said his speech reflected not only his own extraordinary grasp of the situation but also the knowledge and ability of those who assist him. They were grateful to him, and would remember his words most carefully.

"I think it is my job on this occasion to tell you a little about one or two of the many activities of our Association. It is a fact that we train each other because we want to see the whole industry more efficient, and this is perhaps most obvious when we are working together, and with our many friends in related professions and industries on the preparation of British Standards and—more recently—International Specifications and Codes of Practice covering our products and services. We have been particularly happy to work with the very active Committee of European Manufacturers, known as CECOMAF, and are delighted to have M. de Rouvray, General Secretary of that body, among our guests to-day.

"Then many of us were able to attend the Tenth International Congress of Refrigeration held at Copenhagen last August. This in my opinion was


1


2


3


4


5


6


7


8


9


10

Facing page, left to right: 1 and 2—Mr. J. A. Howie and Mr. R. Maudling delivering their speeches. 3—C. R. King; J. R. Cooper; D. B. Irving. 4—I. Campbell; R. Tucker; C. Favier; K. Porter. 5—J. R. Parratt at the microphone. 6—W. Mitchell; F. J. Lawton; J. B. Whalley. 7—C. T. Melling; J. Smellie; G. Y. Dick. 8—N. F. Bradshawe; A. C. Brown; J. G. Haines. 9—R. I. Drake; Ald. A. F. Judd, Mayor of Holborn. 10—D. S. Carruthers; N. F. T. Saunders; E. A. Fowler.

Above, left to right: 1—E. Hall; K. J. B. Webb; K. H. Vere. 2—F. Willoughby; A. J. White; T. Ireland. 3—F. L. Pettman; F. W. Parsonage; C. Blakey. 4—J. D. Coppack; W. Milligan. 5—H. F. Adams; H. S. Reynolds; H. Cameron; C. J. W. Brooks. 6—L. Goodger; T. Gay. 7—W. J. Goddard; A. O. James. 8—L. P. Dack; J. W. Dukes; T. W. Bradbrook. 9—B. T. Smith; F. A. Wallis; 10—J. P. Oake; C. Pierce; V. J. Coppa.

an enormously impressive demonstration of the technical progress achieved by the engineers and scientists in our industry throughout the world, and was remarkable for the wealth of new knowledge gathered as the result of patient research in many countries on many subjects which was so freely made available to anyone. At this Convention the British delegations were very proud to see their own Dr. Fidler receive from the Danish Prime Minister the Otteson Medal awarded for the most meritorious work in the field of food preservation.

"I have picked out these international aspects of the Association's work from the many other activities which you will find in our Annual Report because I am convinced that as the nations of the world draw closer together and, more specifically, as the European Free Trade Area and our Commonwealth both become commercial realities as distinct from political ideals, this form of collaboration will become increasingly vital.

"Talking of the Commonwealth, it is pleasant to notice the discomfiture of those people who have been waiting impatiently to write the last chapters of "The Decline and Fall of the British Empire." They have even had to rewrite some of the earlier chapters because, having recorded that the old British lion had been bombed to death in 1940, and aided to death in 1950, they find that in 1960 he not only still refuses to lie down but has fathered yet another brood of active young lions in the form of the new nations of the Commonwealth. We must realise, however, that these young lions will need feeding and training and, if we don't do it others will be only too glad to take on the job.

"As far as our industry is concerned, it is a fairly obvious conclusion that refrigeration in its various applications, including air-conditioning, is wanted most of all in hot climates. The majority of the underdeveloped countries are in tropical latitudes and refrigeration has a large part to play in their advancement. The rapidly expanding exports of our industry to these countries are proof not only of our ability, but also of our determination to play our full part in this field. In addition, some of us are already setting up indigenous manufacture in these countries in collaboration with local business concerns.

"In all these activities we receive a very great deal of effective practical help from our many friends in the Board of Trade, and I would like to take this opportunity of saying once again how grateful we are to them. Their "home team" is always at our disposal and when we take the trouble to go abroad and find out what is wanted on the spot, their colleagues acting as trades commissioners and their staffs almost overwhelm us with their kindly and competent efforts to assist us.

"Returning to the home market and wrenching over to yet another simile, I have to report that one of our daughters has grown up and left home during my year of office. This is the Domestic Refrigeration Development Committee, christened "DoRDeC" for short, whom we have enjoyed bringing up and whose successes, in coaxing the Government to reduce purchase tax and the public to buy more domestic refrigerators, we have applauded.

"As you have said, Mr. Minister, our industry is thriving and we have every intention of doing all that we can, as one of the many engineering industries of this country, to follow the leadership of you and your colleagues towards a safer and still happier future.

"We know that we are up against strong competi-

Continued on page 394

Left to right: 1—M. Kaye; S. Levington; D. Wright; W. Buchanan. 2—T. Whittaker; J. A. Howie; K. Lightfoot; C. Marks; Col. H. Randal Steward. 3—A. E. B. Wallis, L. G. Turner. 4—A. Grant; R. A. Naybour. 5—R. J. Honniball; M. Horris.

Jacketed Cold-Storage Room for Fish

By A. HEGARTY

ATMOSPHERIC conditions in a refrigerated storage room greatly influence the keeping quality of frozen fish. Tests have shown that in order to minimize loss of quality, frozen fishery products should be stored at temperatures of 0° F. or lower, at a high relative humidity, and at nearly constant temperatures. Many of the frozen food warehouses constructed in recent years have been designed for operation at temperatures of 0° F. or lower. However, conventional methods of providing the refrigeration effect have still been retained. Evaporator cost, space limitations, and other factors peculiar to this design have limited the relative humidity of the product storage area.

In most cases low relative humidity results in increased dehydration and loss in quality. This is especially true for round unpackaged fish or fishery products that are inadequately packaged and kept in a refrigerated warehouse for considerable periods of time. Round fish may be glazed at regular intervals to prevent excessive loss of moisture and subsequent reduction of quality, but no practical remedy has been offered for the protection of inadequately packaged products. Consideration should, therefore, be given to the use of a cold-storage room designed to maintain a high relative humidity and nearly constant storage temperatures.

Studies have shown that a jacketed freezer will maintain high relative humidities and nearly constant storage temperatures. Some jacketed freezers have been built in Canada and the U.S.A.

In order to provide additional information on a jacketed freezer, a room of the size that would be used in a small fishery plant was constructed at the Fishery Technological Laboratory, (East Boston, Massachusetts) of the U.S. Bureau of Commercial Fisheries. Engineering tests were conducted to determine the effects of design on equipment operating characteristics. Frozen storage tests were also conducted to determine the keeping quality of fish stored in the jacketed freezer. The results of these tests were given in a paper presented at the Eighteenth Annual Meeting of the Institute of Food Technologists by Joseph W. Slavin, John A. Peters and S. R. Pottinger, all of the U.S. Bureau of Commercial Fisheries.

Description of Jacketed Freezer

The inside of the storage room of the jacketed freezer used in this study was 10 ft. sq. by 8 ft. high. Cold air was circulated from bottom to top through an enclosed jacket completely surrounding the product storage space. Outside walls of the jacket were constructed of plywood and were covered on the outside with cork insulation 10 in. thick. The jacket was 3⅝ in. wide. Standard 2 in. by 4 in. wooden members were arranged vertically and longitudinally within the jacket. They provided a system of air ducts that permitted uniform distribution of cold air around the periphery of the storage room. The jacket was essentially a closed-duct system within which were located the evaporator and the two fans that provide the necessary circulation of cold air.

Refrigeration was provided by a 7½ h.p. two-stage, water-cooled, "Freon 22" condensing unit. Circulation of air, in the floor, wall, and ceiling ducts of the jacket and over the evaporator coils was maintained by two centrifugal fans. Conventional refrigeration controls automatically maintained the freezer at the desired temperature.

Engineering Tests

Information was needed to determine if the jacketed-type freezer was feasible from an operational viewpoint and information for the design and construction of new and possibly larger freezers of this type was also sought. In order to provide this information two series of experiments were conducted: one on equipment operation, and one on air infiltration. In these tests, measurements were made of air velocity and pressure difference, temperature, relative humidity, and electrical energy.

Test Series I

The purpose of this experiment was to determine the effect of various jacket fan speeds and/or room temperature fluctuations on jacket air flow and jacket duct surface and air temperatures, relative humidity of the product storage area, and electrical energy requirements.

In these tests, the refrigeration equipment was operated in a manner similar to that which would be employed during commercial practice. The evaporator was automatically defrosted with hot refrigerant gas every eight hours. The temperature of the room was controlled by a standard thermostat located in the jacket air chamber and set at a fixed temperature lower than that of the room temperature. The refrigeration compressor was automatically "cycled" on and off by means of a low-pressure switch actuated by the refrigerant suction pressure. The fan was operated continuously except during the defrost period. The room temperature was maintained at $0° \pm 0{\cdot}5°$ F. and at $0° \pm 2{\cdot}5°$ F. Tests were conducted at each temperature range using jacket fan speeds of 82 to 990 revolutions per minute.

Test Series II

The purpose of this experiment was to determine the relationship between the jacket fan speed and the time required for the product storage space to return to its normal operating temperature after being subjected to air infiltration caused by passage of personnel into and out of the room. It was found that in most instances, personnel entered and left the freezer on an hourly basis during the working day. Tests indicated that for a freezer of this size the refrigerator door may in some instances be open as long as 40 seconds each hour.

In this experiment the refrigeration equipment was operated as described previously except the evaporator was not defrosted and the temperature was controlled by a thermostat located in the room rather than in the jacket. Tests were conducted at various jacket fan speeds ranging from 82 to 990 revolutions per minute. At each fan

D

speed, the refrigerator door was opened for 40 seconds at hourly intervals. Storage-room temperatures were recorded at various locations in the room.

These tests showed that the jacketed freezer could be operated satisfactorily at a high level of relative humidity and at nearly constant room temperature.

Specifically, the tests showed that : 1. Relative humidities of 92 to 95 per cent. could be satisfactorily maintained in the jacketed freezer at comparatively low rates of jacket air flow, providing storage-room temperature fluctuations were kept at a minimum of $\pm$ 0·5° F. 2. Temperature fluctuations of $\pm$ 2·5° F. resulted in a decrease in room relative humidity. At this temperature, increased jacket air flow was necessary in order to accomplish the required refrigeration effect. 3. Equipment electrical energy requirements varied with room temperature and jacket air flow and were 20 to 22 per cent. higher than were those of a conventional-type freezer, operating under optimum conditions. 4. Recovery time due to traffic of personnel increased with a reduction in jacket air flow. 5. In the application of a jacketed cold-storage room, particularly a small room of the size of the test room, every effort should be made to keep load conditions as constant as possible in order to maintain a high relative humidity, low rate of jacket air flow, and low equipment operating costs.

Frozen Storage Studies

Studies were also conducted to determine the keeping quality of some fishery products stored in the jacketed freezer, and in conventional-type cold storage rooms using overhead plate-type evaporators (laboratory cold-storage room) or finned-pipe-coil evaporators (commercial cold-storage room).

During these tests the jacketed freezer was operated at a temperature of –5° F. $\pm$ 0·5° F. The temperatures of the laboratory and commercial cold-storage rooms ranged from 0° to –5° F. Relative humidities were 90 to 95 per cent. in the jacketed freezer, 80 to 85 per cent. in the commercial cold-storage room, and 70 to 80 per cent. in the laboratory cold-storage room.

Some results of storage tests on frozen shrimps, haddock fillet blocks, haddock fish sticks, and round albacore tuna are given below.

Commercial samples of peeled, deveined, individually frozen and glazed pink shrimps, packed in waxed chipboard cartons and over-wrapped with waxed bleached sulphide paper, were stored in the jacketed freezer and in the laboratory conventional-type cold-storage room. After nine months of frozen storage the shrimps in the jacketed freezer had still retained their glaze and normal pink colour, whereas others stored in the conventional-type cold-storage room had faded and were badly discoloured, showing evidence of considerable dehydration. The appearance of the shrimps stored in the conventional-type cold-storage room was so poor that they were considered to be unacceptable after the ninth month of frozen storage. However, the shrimps stored in the jacketed freezer were still of good quality at 12 months of frozen storage.

Commercial samples of haddock fillet blocks (weighing 13·5 lb. each) packed in waxed chipboard cartons without overwraps and stored in the jacketed freezer or in the commercial cold-storage room were examined periodically during frozen storage for changes in weight and quality. The results of the examination for weight loss showed that, after a year of frozen storage, samples stored in the conventional cold-storage room lost about seven times more weight than did samples stored in the jacketed freezer.

Results of tests by a taste-panel of 10 judges, for flavour, odour, appearance, and texture showed both samples to be of a very good quality.

Commercial packages of haddock fish sticks weighing 10 oz. overwrapped with freezer type film had been stored for 12 months in a conventional-type cold-storage room and in the jacketed freezer. The packages stored in the jacketed freezer did not undergo any measurable weight loss during the 12-month storage period, whereas those stored in the conventional cold-storage room had lost almost 1 per cent. in weight during this same period. The results of taste-panel tests for flavour, odour, appearance, and texture showed a consistent but not statistically significant preference for the fish sticks stored in the jacketed freezer.

Samples of frozen round albacore tuna (each fish weighed about 54 lb.) had been stored unglazed in the jacketed freezer and in a conventional-type cold-storage room for 10½ months. The weight lost after 10½ months of frozen storage by the tuna stored in the conventional cold-storage room was over 20 times greater than the weight lost by the tuna stored in the jacketed freezer. No organoleptic tests were conducted on these fish.

Practical Application

The cost of constructing a jacketed freezer was estimated to be slightly higher than that of a conventional-type cold-storage room. This cost combined with the increased cost of equipment operation made the jacketed freezer look somewhat unattractive from an economic viewpoint. However, the jacketed freezer did offer some advantages which would justify or offset these additional costs. These advantages were:

(1) A high relative humidity and nearly constant storage temperatures could be maintained resulting in minimum dehydration and increased shelf life of products.

(2) Evaporator coils would be defrosted automatically. Therefore, additional labour was not required for scraping the frost off the evaporator coils as it was in most conventional-type cold-storage rooms.

(3) There was no forced air circulation in the storage room as there was in many conventional-type freezers. This further reduced loss of quality.

(4) The refrigeration equipment could be operated automatically using standard control devices.

(5) There were no warm wall or floor surfaces as in conventional storage rooms; each section of the jacketed freezer room was at the same temperature. This ensured uniform product temperature.

(6) Products slightly above the storage-room temperature could be lowered in temperature by opening doors connecting the jacket with the room. This allowed forced air circulation through the storage room and rapid cooling of the product.

"METHANE PIONEER" TRIALS

"Methane Pioneer," the prototype tanker owned jointly by the Gas Council and Constock International Methane Limited of America which has been carrying methane in liquid form from the United States to the North Thames Gas Board's marine terminal at Canvey, has made its final delivery in the series of seven trial voyages undertaken in connection with the development of the transportation of liquefied natural gases.

During the trial over 12,000 tons of methane have been delivered and converted by the North Thames Gas Board to town gas. With the successful completion of the trial stage of the developments the ship is to be laid up in a British port pending a decision on her possible assignment to other service. The trials have provided valuable information for the consideration of possible large ship operations.

Domestic Refrigeration Trends

Ideal Home Experiences

WHAT does the housewife look for when she goes to buy a refrigerator ? At the domestic refrigeration industry's best shop window of the year, the Ideal Home Exhibition, record sales and enquiries convinced manufacturers that their products were on the right lines. With national prosperity at a relatively high level and with 80 per cent. of British homes still without a refrigerator, the industry is enjoying a boom, but exhibitors at Olympia reported a number of interesting trends in the housewife's approach to buying a refrigerator which suggest that although she is anxious to have one, she is not prepared to have the first one that comes along.

It is interesting to consider her preferences in the light of the industry's recent past.

In anticipation of spring sales nearly 90,000 machines of both home and foreign make were put on the market in January. During the same month, U.K. production was 87,000, an increase of 80 per cent. over the corresponding period of 1959. All but 7,000 went to the home market, an indication that the sharp upward trend in demand during 1959 (when sales were twice as great as in 1958 and three times the 1957 level) is to continue.

Over the past few years, by comparison with other countries, the market penetration of refrigerators has been low, and most housewives seem to have preferred other household appliances. The limited capacity of the industry was therefore unable to meet last year's demand, due mainly to the exceptional summer weather. The present rise in sales shows the wholesalers' and retailers' determination not to be caught with insufficient stocks once again, with the period of peak sales just ahead.

One of the most prominent features of the refrigerator market in 1959 was the steep rise in imports. Faced with unusually high summer demand, retailers were caught off their guard, and U.K. manufacturers needed time to catch up with the upsurge. This left scope for a considerable increase in imports, which rose from under 2,000 in January to over 36,000 in July (equivalent to about one third of U.K. output in that month).

These figures do not include refrigerator parts imported

The refrigeration section on the Electrical Development Association's stand at the Ideal Home Exhibition, Olympia.

and subsequently made up in the U.K. of which £300,000 worth came in last year. Since July imports have shown the normal seasonal decline, but at more than 8,500, the January import figure is nearly five times its 1959 equivalent.

In cost, imported models are very close to those of U.K. manufacture. Although the retail price in Germany, for example, is only just over half the final price in the U.K., the difference is made up by transport costs, import duty (at about 15 per cent.) and purchase tax.

Medium Sizes Still Popular

The greatest volume of interest at the Ideal Home Exhibition was taken this year in the 4 c.ft. sizes (last year well over half the refrigerators sold were this size or under) particularly for people buying for the first time, but manufacturers also reported a high level of sales for the larger versions, most of these to households already possessing cabinets and coming back to choose larger ones.

White is still by far the most popular colour for exteriors and no-one seems unduly impressed by the extents to which manufacturers have gone to provide colourful interiors. Once the door is opened attention is immediately turned to layout. Square designed units proved themselves at the Exhibition and it was generally agreed that the "table top" provided by these was the greatest selling point. The housewife, however, still tended to be less conscious of appearance and more conscious of interior design.

All manufacturers reported a lack of education in the public in the use to which deep-freezing compartments can be put. Most people imagined that the use of these was restricted to the preservation of frozen foods and the manufacture of ice cubes. Many were surprised to know what could be done.

High levels of business were largely due to the H.P. facilities available, and several manufacturers expressed concern at the extent to which people were willing to commit themselves. It was generally agreed, however, that there was more money around, and the numbers of people who came and, once decided, paid cash on the nail, was surprising.

To sum up: While there is a boom, refrigerators of all sizes, shapes and colours will sell, but experiences at the Ideal Home this year indicate that greatest sales, probably for as long as five years, will be in the table top and medium capacity refrigerators, white, squared up, incorporating spacious deep-freeze compartments, and with well designed interiors. The housewife has paid willingly for what she wanted this year, so the price of his product is not the greatest of the manufacturer's worries.

THERMO PLASTICS LTD., EXPANSION

LATEST stage in a programme of expansion being organized by Thermo Plastics Ltd., Dunstable, and its associate Mendip Ltd., was marked recently by the opening of a new office and administrative block at Dunstable, Beds. The two companies, which are members of the Tootal group, manufacture a wide range of products in plastics and resin bonded glass fibre for many industrial applications, as well as a number of successful consumer goods.

Thermo Plastics Ltd. is well known for the refrigerator liners which it produces for a number of companies including English Electric, A.E.I.-Hotpoint, Kelvinator, Astral, and Electrolux. Expansion in this section of the group's activity will include the installation at the end of this year of a 300 oz. injection moulding machine; the liners are at present manufactured under the vacuum forming system. Production of these units which at the present time varies from 8,000 to 10,000 per week, is centred at the firm's 200,000 sq. ft. factory at St. Helen's, Lancs.

This section of a swimming pool, manufactured for marine use by Thermo Plastics Ltd., is moulded by hand lay-up method in glass fibre reinforced resin and has a pigmented inner layer.

Thermo Plastics Ltd., was founded in 1932 to manufacture, in premises in central London, fascia letters, signs and display items from cellulose acetate, one of the few sheet plastic materials available in those days. It was soon realised, however, that this material was of tremendous potential value to industry in general and had applications in a far wider sphere than the one in which it was then being used. Experiments followed, and within a few years a range of plastic components for the aircraft industry was being produced. During the war, the company was wholly engaged in the construction of aircraft parts such as cockpit canopies, radomes, air ducts and air chutes.

Immediately after the war attention was turned to the manufacture of plastic domestic articles, catering equipment and sanitary fittings such as tea trays, cups and saucers, food covers, sink and draining board units and wash basins. At the same time exploration began again from where it had been abandoned in 1939 into the possible industrial uses of the materials now available. By 1948 Thermo Plastics Ltd. had become well known throughout the country for its contribution to British industry in the field of plastics.

Some of the largest mouldings in the country for plastic displays and signs were developed by Thermo Plastics Ltd. and today the products of these moulds, in the form of outdoor signs and displays, are in use all over the world.

T. WALL & SONS

OPEN NEW

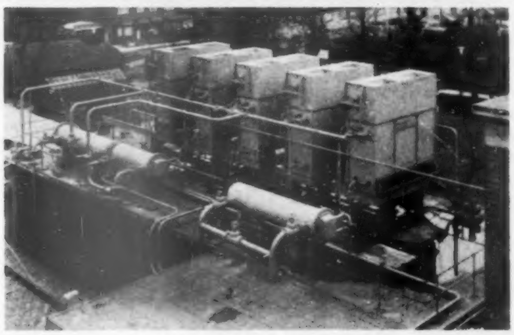
COLD STORE

Interior of the 590,000 cubic foot store

ACTON EXTENSION

IN preparation for what is expected to be a record season for ice-cream sales, T. Wall & Sons (Ice Cream) Ltd., have built a new cold store at their Acton factory. The new store, which was erected for the company by Laings, is 250 ft. by 100 ft., has a capacity of 590,000 cubic feet and will hold 25,000,000 portions of ice cream, enough to serve the entire south-eastern part of England. The Lightfoot Refrigeration Co. Ltd. supplied and installed the cooling plant.

To keep ice cream in perfect condition, temperatures in the cold store go as low as 50° F. below freezing. The store which is built on 3 ft.-concrete stilts to allow air to circulate underneath, is of envelope construction. Walls and ceiling are insulated with 12 in. of cork. During peak seasons 60 men will be working at the cold store, 20 of whom will spend most of their time inside. The cold store includes offices, rest-rooms, cloakrooms and tea-making facilities, largely for the benefit of the "inside" men who work at sub-zero the year round. Wall's researchers working with specialists on Arctic conditions, have developed special protective clothing for the cold store men which is so efficient that the men can work in the extreme cold up to an hour at a time.



Over-all view of the new cold store at Acton and some of its roof installations.

Forty-five vans will be attached to the cold store. Three are normally loaded at a time, but five can be loaded at once during a rush. At peak efficiency up to 12,000 gallons of ice cream can be loaded per hour. The operation is speeded up by retractable conveyors which lead right from the cold store into the vans. The heights of these conveyers can be adjusted to the floor level of whatever van is being loaded.

Ice cream is packed into cans in the factory and the cans are loaded on to trolleys running on an overhead line. The trolleys travel from the factory into the cold store where they arrive on a mezzanine, and the cans are loaded into pallets holding the equivalent of 200 gallons of ice cream. Loaded pallets are picked up by fork lift trucks and carried off the mezzanine to the storage area, to be stacked three-high.

Re-Icing Insulated Railway Trucks

An automatic plant which is capable of re-icing 1,400 insulated railway trucks daily, has been brought into operation by the City Products Corporation, of Blue Island, Illinois. The plant is one of the largest and most efficient of its kind in the United States. When a train enters the company's dock ready for loading, 400 lb. blocks of ice are mechanically transported from day storage to the loading area by chain conveyer. This conveyer discharges onto a second which runs down the whole length of the loading area. Three large icing machines, which run on rails adjacent to the train, pick up ice from the conveyer, crush it to suitable size, and deliver it into the bunkers at each end of the trucks. The machines, which are 12 ft. high, are each operated by one man who has full control of the conveying and discharging operations in his own area. The company's ice manufacturing plant produces about 200,000 tons annually. Forty trucks can be handled in one operation.

Blood Storage

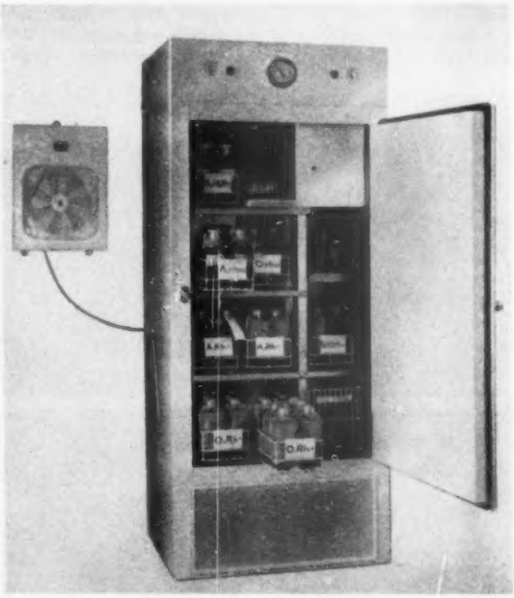
DEVELOPMENTS BY WIRRAL REFRIGERATION

REQUESTS by hospital authorities for refrigeration equipment for the storage of blood have, in the past, been met largely with units modified for that application. Disturbed by the general situation about five years ago, the National Blood Transfusion Officers Conference of the Ministry of Health issued a number of recommendations for the storage of blood, and a series of units conforming to the specifications are now being manufactured by Wirral Refrigeration Ltd., 27 Woodchurch Road, Birkenhead, Cheshire. A new division of the company was formed about nine months ago following an intensive period of research, and refrigerators are being made not only for blood storage but also for keeping eyes, freeze drying proteins, and for research applications.

Adopting the trade name "Cardiff" the company introduced its series of blood bank cabinets about six months ago and approximately 50 have now been installed. Three sizes of cabinets are available, the 60, 90 and the 120 with their tropical counterparts the 60X, 90X and 120X. The motor compressor units fitted to these three machines, models C4614 and C3N16, are manufactured by L. Sterne & Co. Ltd., Glasgow.

The specifications issued by the Blood Transfusion Officers were as follows :

1. Convenient and easy access to any bottle in the refrigerator.
2. Accurate temperature control to maintain automatically 4° C plus or minus 1° C.
3. Complete humidity control to prevent condensation on bottles so that labels remain legible and in place at all times.
4. Emergency hold-over to ensure that the temperature in the refrigerator will not rise above 10° C. with the door closed giving a hold-over over 18 hours during breakdown or stoppage through electrical supply failure, etc.
5. Even temperature throughout the storage space within 0·5° C.
6. Storage arrangement to enable blood of each particular group to be stored independently and individually. Separate storage, therefore, for O.RH positive, O.RH negative and the blood for the other groups -A, B and AB.
7. A separate storage compartment which is lockable for blood awaiting investigation for one reason or another.
8. A fixed shelf of fine mesh to hold test tubes and small samples.
9. Dial thermometer fixed to the cabinet and immediately visible for quick checking.
10. An electric or 7-day or 24 hour clockwork recording thermometer fixed adjacent to the refrigerator to cover the full operation of blood storage. Charts to provide a continuous line record with easy change charts.
11. Safety arrangements to include for an alarm system to operate independently of mains supply, the alarm to sound if the temperature falls below 2° C. or rises above 8° C.
12. The refrigerator to be equipped with a fully automatic defrost system with external draining.
13. Standard cabinets to be manufactured to accommodate 50 to 100 bottles.
14. The appearance to match up with standard laboratory equipment.
15. The bottles to be held firmly to prevent overturning yet be easily withdrawable.
16. The refrigeration system to be of the hermetic type for silence and should be free of all vibration.
17. The Cabinet door to be fitted with lock device.
18. In addition to low temperature cabinet for the storage of typing sera and frozen plasma for use with each blood bank cabinet.



The "Cardiff" Blood Cabinet.

The cabinets store 60, 90, and 120 pints of blood, respectively, and in each cabinet a special compartment is provided so that blood unfit for transfusion can be locked away. A special feature of the cabinet is the com-

partmentation whereby in conjunction with a temperature recorder, a full history of the blood stored can be filed. Any temperature fluctuation is thereby recorded and there is no danger that blood will be used that has been subjected to a rise above 10° C or a fall below 2° C. Outside of these limits there is a possibility that the red cells might be ruptured and if this blood was used haemolysis could occur through haemoglobin being liberated, inducing a dangerous condition.

Forty per cent. returned

Blood is given voluntarily by donors and it is the interest of everyone to see it is not wasted. No figures are available, but it is estimated that at least 40 per cent. of blood is returned from hospitals as unfit for use. Due to the fact that whole blood is considered to be unfit for transfusion after 21 days, a considerable amount is returned to the centres so that the red cells can be separated and the plasma processed for transfusion in cases of burns, oligaemic shocks, etc. Quite large quantities are returned due to refrigerator breakdowns, and these are the losses to be prevented, hence the necessity of temperature hold-over arrangements in the blood bank during emergency conditions.

Tests have shown that the cabinet, which is insulated with 3 in Onazate (The Expanded Rubber Co. Ltd.), gives a hold-over of 12 hours with the door closed during which period the temperature of the blood does not rise above 10° C. when the ambient temperature is maintained at 28° C. Additional hold-over is given by eutectic plates holding –3·5° C. solution increasing the hold-over period by 12 hours in a similar ambient.

Kick plate fitted to the Lec International refrigerator is moulded in Rigidex high density polythene supplied by British Resin Products Ltd. It is, the makers claim, virtually unbreakable and cannot dent, chip or corrode.

The plastic covered baskets which each hold 10 pints in standard transfusion bottles are fitted on retractable shelves with safety stops. The tropical models have insulated fronts to the baskets, which act as humidity doors and prevent excess air spillage during use when the main door is open.

Alarms are fitted to the cabinet which operate independently of power supply to ensure the following :—That the alarm rings when : (1) temperature rises above 6° C. ; (2) the temperature falls below 2° C. ; (3) if unit fails ; (4) if power fails ; (5) through loss of refrigerant ; (6) if restrictor chokes ; (7) when the door is opened, under emergency conditions.

The distant alarm equipment which is suitable for siting up to 100 yards from the cabinet, is synchronised to operate with any cabinet failure as above.

The recording thermometer is fitted adjacent to, but not fixed to the cabinet, and it gives an accurate, permanent and continuous record of stored blood temperatures. The sensitive temperature phial is immersed in water in a stainless steel container at the rear of the cabinet. This device records the actual temperature of the blood stored and not the temperature of the air which, necessarily, may vary when the door is opened. The recorder can be provided operated either by clockwork or electricity. Either device gives continuous recording, the former for 7 days and the latter indefinitely. Change of charts is easy and 100 charts are provided with each recorder.

The refrigeration system employed, embodies a hermetic motor compressor, primary and secondary condensing, multi plate evaporator, automatic defrosting and evaporation of condensate.

This system which has now been well proved, has been designed to give quick recovery of temperature in the cabinet and to obviate all disadvantages to the user.

The models 60, 90 and 120 are designed to maintain automatically in the cabinet a temperature of 4° C. plus or minus 0·5° C., and under emergency conditions to give a hold-over capacity ensuring that the temperature of the blood stored will not rise above 10° C. with the door closed, the effective hold-over period being over 18 hours. The company has assumed in its calculations that the ambient temperature will not exceed 28° C/82·4° F., and that air not exceeding this temperature will be available for the condenser of the refrigerating machine.

The models 60X, 90X and 120X are designed to maintain automatically in the cabinet a temperature of 4° C. plus or minus 0·5° C., and under emergency conditions to give a hold-over capacity ensuring that the temperature of the blood stored will not rise above 10° C. with the door closed, the effective hold-over period being over 14 hours. The company has assumed in its calculations that the relative humidity will not exceed 85 per cent. and the maximum ambient temperature will not exceed 45°C./113° F., and that air not exceeding this temperature will be available for the condenser of their refrigerating machine.

P.S. LOW TEMPERATURE GROUP SYMPOSIUM

A One Day Symposium on "Low Temperature Techniques" (measurement and control of flow, level, temperature, pressure, etc.) was held on March 11th at the Institute of Physics, 47 Belgrave Square, London, S.W.1. The papers given were as follows : "A view of low-temperature instrumentation development," by Mr. H. E. Charlton (H. E. Charlton Engineers Ltd.) ; "A review of laboratory techniques," by Dr. A. C. Rose-Innes (S.E.R.L.) ; "The use of industrial measuring instruments under low temperature conditions," by Mr. B. Blay (B.O.E.) ; "Measurement of the temperature distribution near a falling free surface of liquid oxygen," by Mr. J. W. Armond (B.O.R.A.D.) ; "Flow, temperature and pressure measurement techniques as applied to rocket engine systems," by Dr. I. E. Smith (Rolls Royce Ltd.) ; "Laboratory automatic control system for helium gas," by Dr. A. Johnson (R.R.E.) ; "Instrumentation in the production of hydrogen and helium," by Dr. B. Figgins (B.O.R.A.D.) ; "Flow metering of cryogenic liquids," by Mr. A. Allen (B.O.R.A.D.).

DEVELOPMENT OF REFRIGERATION IN FRANCE

Many of our readers having toured through France on their vacations, will have noticed an upsurge in refrigerator production in that country. Below are given data on the French industry.

REFRIGERATION has become an established feature in French homes. Among electric household equipment, the sales charts of domestic refrigerators in recent years show steeply ascending curves. Technical progress and the improvement in the standard of living have contributed to a large extent to the development of the still relatively young industry which, however, meets such a great need in modern life that its expansion will cause a revolution in the economic life of the country. Its size, its present economic position, and the opportunities presented through the Common Market, are all factors justifying an examination of its development.

Refrigeration equipment in the three categories—commercial, industrial, and domestic—has undergone prodigious development, both technically and economically. The French pre-war market for domestic refrigerators was very small, although several manufacturers existed at that time. Exact statistics are not available, but it has been estimated that annual sales approximated 60,000 units. Since then, production figures have increased steadily (very rapidly until 1952, when they levelled off) and showed a rate of 25 per cent. until 1957, which was a record year with sales amounting to 600,000 units.

At the moment, the inventory of refrigeration units in homes is estimated at 2,400,000 units, representing 18 per cent. of the ideal total, or the possession of a refrigerator by one out of every six homes. If it is considered that this rate was only 5 per cent. in June 1952, it becomes evident that domestic equipment has almost quadrupled in six years. France has naturally not yet reached the degree of saturation of the U.S.A. (97 per cent.), nor the rate existing in Sweden (50 per cent.), but its position comes close to that of Great Britain (13 per cent.), Italy (11 per cent.), Denmark (25 per cent.) and Germany (23 per cent.).

The great change in the composition of buyers is most remarkable. In 1939, a refrigerator was an expensive luxury. Now it has become an object of everyday life necessary to any home, and may be found more and more frequently in families with average incomes.

A breakdown by buyer groups per 100 units sold, for the years 1949 and 1954, shows the following figures :

	1949	1954
Factory or store owners	43	28
Public or private employees	26	33
Retired or pensioned persons	17	10
Farmers	9	9
Workers	5	20

Since then, this tendency has been confirmed, although it has not been possible to establish exact statistics. Future estimates assume that the present figure of 9 per cent. for sales to rural customers will go up considerably, particularly in view of the fact that these potential customers represent 20 per cent. of the total of French homes.

A breakdown of buyers by age of the mistress of the home is no less interesting. For reasons primarily founded on the standard of living, the rate of distribution is slightly higher in homes where she is middle-aged. But for those " under 35," it is also above the average and indicates the need for domestic equipment of the younger generation which was aided at the time by credit purchase.

Although, in 1939, almost the entire domestic market was supplied by imports, it is now—and especially at the present moment—being supplied by units manufactured in France. From 1952 to 1955, only 25,000 units were imported, compared to 1,500,000 produced in France. Exports, on the other hand, are still limited. Sales to France's overseas territories totalled 25,000 units in 1955, and 30,000 in 1957. Exports to foreign countries are still relatively small, but are growing. They amounted to about 15,000 units in 1958, excluding the overseas territories.

The growth of sales resulted in mass production, and an appreciable improvement in productivity, which have both influenced the price of the equipment. Even though the general index of wholesale and retail prices rose from 143 to 149·7 between 1952 and 1957, that of refrigerators fell from 118 to 105, and is a measure of the efforts expended by the manufacturers in this field.

The improvement in quality is another factor that will have a large bearing on the future. Here the French refrigeration industry is one of the first in the world, a result that is definitely due to the influence of the quality label " NF FNAF " (created in 1952), whose specifications have spurred the manufacturers into constant research for greater efficiency of the units.

On the home market, the future seems assured. The potential is far from saturated, the desire for purchase real. The industry should, however, intensify its efforts to inform those who are not convinced of the refrigerator as a necessity in the home. This concerns primarily the rural market and the average income homes.

On the external market, the problem is totally different. The future of this market depends principally on the effort made in the direction of exports and pre-supposes—because everything is interrelated—the maintenance of a large interior market as the necessary base for all export activities and the improvement of the means of production to attain large-scale mass production and increased productivity. France occupies third place among world producers and is in a position to assume its role in international competition.

Let us now examine industrial and commercial refrigeration in French economic life.

The large number of refrigeration compressor manu-

facturers may seem surprising. Excluding those that confine themselves to the design and construction of special equipment, and those that build very special types of compressors, there are still 23 manufacturers left of industrial equipment, and 15 in the commercial field, according to figures supplied by the industry association.

In the field of commercial equipment, a certain concentration has occurred. As an example may be quoted the company which has replaced the now insufficient manufacturing facilities, built in 1948–9, by a plant four times the size of the old, so as to satisfy home market requirements and to be in a position to compete on foreign markets.

The technical characteristics of French equipment are fully capable of satisfying the users' needs, whether this concerns high-speed multi-stage compressors and high-output heat exchangers, or centrifugal compressors. All types of refrigerating media, such as NF_3 and the "Freon" gases, are utilized in accordance with the latest methods of technical progress.

The productive capacity of the specialized French manufacturers largely exceeds the requirements of home consumption, so that they are capable of filling orders very quickly in many cases, and of competing successfully with the best foreign firms, Cold storage warehouses and ice manufacturing plants of French origin have been erected in the Middle East and centres for the preparation of dried-blood plasma have been equipped by French companies in Italy, Poland, Hungary, and South Africa. Ships built in France for the U.S.S.R., Sweden, Chile, and even Britain, have been furnished with French refrigeration equipment.

The growth of refrigerated storage capacity from 1954 to 1957 may be seen from these figures : 1954 : 240,000 units sold (representing 812,250 c.ft.), 1955 : 290,000 units (1,236,000 c.ft.), 1956 : 390,000 units (1,801,000 c.ft.), 1957 : 590,000 units (2,860,500 c.ft.). Over the same period, the average capacity of units sold was as follows : 1954 : 95 litres ; 1955 : 110 litres ; 1956 : 126 litres ; 1957 : 137 litres. (1 litre is 0·035 c.ft.).

LEVIN DISTRIBUTORS' CONFERENCE

Distributors attending the conference were guests of Levin at an informal dinner at the Cafe Royal, London, on February 23.

A CONFERENCE for United Kingdom distributors of frozen food cabinets manufactured by Aktiebolaget K. J. Levin, of Malmö, was held at the Washington Hotel, London, on February 22 and 23.

Representing the Swedish firm at the conference were Mr. H. Henriz, sales director, A. Jönsson, sales office manager, and P. Billgren, service manager. British companies represented were : the Bland Refrigeration Co. Ltd., Richmond, Surrey (G. C. Bland, managing director, M. E. Corfe, general manager, and Mr. Bostock). L. Block & Co. (Refrigeration) Ltd., Nottingham (Leo Block, managing director).

Dollar-Rae Shopfitters Ltd., Glasgow (G. D. McIlvain Snr., managing director, G. D. McIlvain Jnr., refrig. manager, J. R. Gordon, general manager). Exeter Refrigeration Co. Ltd., Exeter (A. T. Bottomley, managing director).

Fred Hawkes (Refrigeration) Ltd., Rushden, Northants. (G. P. Robinson, managing director). H. & E. Engineers Ltd., High Wycombe and Oxford (M. W. Wood, branch manager, G. Byrne, service manager). J. T. Herbert Ltd., Sittingbourne, Kent (J. T. Herbert, managing director, H. L. Bennett, sales manager). Ice-Berg Refrigeration Co. Ltd., Plymouth (N. W. Smith, director).

Masscold Ltd., Hull (W. E. Delany, managing director). Playle of Maldon Ltd., Witham (Alfred S. Playle, managing director). P. B. Refrigeration Ltd., Stockport (A. Briggs, managing director, Mrs. J. Briggs, secretary). Refrigeration (Cornwall) Ltd., Newquay, Cornwall (L. T. Pryor, managing director). Refrigeration Co. (Lincolnshire) Ltd., Lincoln (D. A. Fell, manager). Refrigeration Sales & Service Co., Swansea, Wales (E. B. Lloyd, managing director). J. W. Russell Ltd., Watford (D. T. Russell, managing director, P. R. Leslie, sales manager). Sarum Refrigeration Service Ltd., Salisbury, Wilts. (A. F. Rigiani, managing director).

THE INTERNATIONAL INSTITUTE OF REFRIGERATION

Summer Meetings of the Commissions

Commission 1. Scientific problems related to low-temperature physics and thermodynamics. Industries using very low temperatures and rare gases.

Commission 1 of the I.I.R. will meet on June 28, 29 and 30, at Eindhoven (The Netherlands) at the Philips Research Laboratory.

The working programme of this meeting is as follows :—

(*a*) Refrigeration, liquefaction and separation processes at low and very low temperatures ;

(*b*) Thermodynamical properties of fluids, mixtures and solids at low temperatures ;

(*c*) Application of low temperatures (*e.g.* masers, superconductors, high magnetic fields, bubble chambers).

The meetings will include invited papers in the morning sessions while a small number of contributed papers can be read in the afternoon sessions.

In order to prepare preprints, the organizing committee has decided that those intending to read a paper are invited to submit to the secretary of the organizing committee :—

(1) An abstract of their paper not exceeding 150 words before March 1 ;

(2) The complete text of their contribution limited to 2,000 words and six figures before April 1. Those intending to attend the meeting are invited to write as soon as possible to Mr. J. R. van Geuns, Philips Natuurkundig Laboratorium, Eindhove (The Netherlands). Registration is, in addition, required for securing accommodation at Eindhoven.

Commissions 3, 4 and 5. Three commissions of the International Institute of Refrigeration, Commission 3 (design, construction and operation of machinery for refrigerating and air-conditioning plants), commission 4 (applications of refrigeration to foodstuffs and agricultural produce) and commission 5 (cold stores and ice-making plants) will meet in Marseilles from September 6 to 9.

The subjects to be dealt with are as follows :—

Commission 3 : Design of evaporator systems, including controls (joint session with commission 5).
Absorption machines and steam jet systems.
Industrial plants for the temperature range 100° to 200° K. (-99·4° to -279·4° F.).

Commission 4 : Prepackaging of chilled and frozen foodstuffs.
Quality of frozen foods (joint session with commission 5).
Cooling of cut flowers and bulbs.

Commission 5 : Cold-storage guide.
Design of doors for cold stores.
Jacketed cold rooms.

It is probable that sub-commission 6A (air-conditioning) will also meet in connection with commission 3. The subjects to be dealt with will be mentioned later.

The meetings will follow a " refrigeration session " organized by the French Association of Refrigeration in Marseilles on September 5. They will include some technical visits in Marseilles and its surroundings.

Those intending to present papers on the above-mentioned subjects are requested to submit the title of their paper to the presidents concerned as soon as possible.

Commission 3 : Prof. G. Lorentzen, Norges Tekniske Hogskole, Institutt for Kjöleteknikk, Trondheim (Norway).

Commission 4 : Prof. J. Kuprianoff, Bundesforschungsanstalt für Lebensmittelfrischhaltung, Karlsruhe 17-A (Germany).

Commission 5 : M. J.-B. Verlot, Direction Commerciale de la S.N.C.F., 54, Bld. Haussmann, Paris (France).

Papers, in French or English, will include 2,000 words at most.

Synopses of papers

at

A.S.H.R.A.E. MEETINGS IN DALLAS, TEXAS

First Technical Session

An Analysis of the Necessity to Insulate Floors of Cold-storage Rooms at 35° F., by Prof. J. D. Hovanesian, Pennsylvania State University, Prof. H. F. Pfost, Kansas State University, and Prof. C. W. Hall, Michigan State University. The authors investigated experimentally the justification of the prevailing general practice of applying insulation to slab-on-soil floors in such structures, and questioned the need of applying the insulation.

A Method of Comparing Heat Exchangers, by D. G. Rich, Carrier Corporation, Syracuse, New York. Under conditions considered necessary for making comparisons, the author concluded that a single chart suitably plotted could serve as a valuable basis for the comparison and eventual optimization of the geometry of heat exchangers. Such a chart was included in the paper.

Frost Formation on Refrigeration Coils, by Prof. W. F. Stoecker University of Illinois. Initial deposit of frost on a horizontal pipe coil roughened the surface and increased the transfer coefficient. As more frost accumulated the coefficient remained somewhat steady and dropped only when further accumulation began to block the air passages. The constant coefficient came about as the result of two opposing causes. The author showed how the presence of neighbouring pipes and radiation from them increased the transfer from them and caused an accelerated rate of frost deposit on the tube sides.

Frost Formation upon a Thin Aluminium Tank containing Liquid Oxygen, by J. L. Loper, The Western Company, Fort Worth, Texas. The author presented results of an analysis of heat flow as frost built up on a cold cylindrical uninsulated tank exposed to the atmosphere without direct solar radiation. Calculation results indicated that after about one hour the frost formed an effective thermal insulation. High humidity caused more rapid frost build-up. Wind was important initially.

Second Technical Session

Noise Reduction Characteristics of Package Attenuators for Air-conditioning Systems, by Norman Doelling, Bolt, Beranek and Newman, Inc., Cambridge, Massachusetts. Based on measured characteristics of about 20 commercially available packaged noise reducers by the end difference method, the author found that length and percentage of open area were the only important variables which affected the noise reduction values. He included some simple rules of thumb for selecting appropriate mufflers.

Attenuation and Generation of Sound in Elbows with Turning Vanes, by W. F. Kerka, A.S.H.R.A.E. Research Laboratory, Cleveland, Ohio. The study aimed at obtaining information on elbows with vanes, which information could be applied in predicting the acoustic performance of duct systems, and hence included studies of insulated and uninsulated ducting of different sizes and aspect ratios. Results of a correlation of the sound

attenuation and generation in elbows versus size, aspect ratio, and angle were also included.

Draft Performance of Chimneys, by W. G. Brown and C. Wachmann, National Research Council of Canada. The author reported results obtained with a full-size masonry chimney and compared them with previous data and with calculations based on model tests. The measuring method permitted the influence of wind to be separated, and when this effect was eliminated, a strong natural convection influence was shown, with friction losses much higher than in isothermal flow. Three chimney heights were studied (6, 16 and 23 ft.). At low gas flow rates, the shortest chimney showed the greatest efficiency, but at high flow rates, the 16- and 23-ft. chimney excelled in performance. Other correlated test data were included.

Saturated Steam Flow in Copper Tubing, by C. M. Humphreys, J. T. Baker and B. H. Jennings, A.S.H.R.A.E. Research Laboratory, Cleveland, Ohio. In this paper, charts were presented based on d'Arcy formula, for 3½- and 12-p.s.i.g. steam flowing in copper tubing 2½ in. in diameter and smaller. Pressure drops in smaller copper tubes (⅜ to 1½ in.) were determined experimentally, with good agreement found with the formula results for average flow rates. Studies of critical velocities above which condensation in mains would be carried into 45 degrees upturned tees were made in small tube sizes (⅜ to 1½ in.) and were found to increase with tube size, and to occur at approximately constant pressure drop.

Re-evaluation of the Steam-pipe Size Tables for the A.S.H.R.A.E. Guide, by W. F. Kerka, A.S.H.R.A.E. Laboratory, Cleveland, Ohio. This paper consisted of an analysis of the genesis of the data on steam flow in pipes in editions of *The Guide* prior to 1959, together with an explanation of how the revised information in the 1959 edition was obtained. Examples were given of how the newly-presented data was applied, and the need for a study of condensate flow in return piping was noted.

Third Technical Session

Effect of Compressor Characteristics on Motor Performance, by E. H. Jensen, Westinghouse Electric Corp., Staunton, Virginia. A pulsating load decreased the power factor of a motor, said the author, and an analysis of instantaneous motor currents showed there was a relationship between compressor design and the varying currents. A theory was presented to explain why different types of loads resulted in different power factors for the same motor. With ordinarily available designs there was a variation of as much as 25 per cent for the same cooling capacity. An over-sized motor would draw a higher current than would be expected on the basis of power factor alone.

Muffler Analysis by Digital Computer, by D. F. Miller and B. W. Hatten, Westinghouse Electric Corp. The method of analysis presented in this paper was based on the distributed element equations representing the vibration of gas within a tube. Computation was handled by a high-speed digital computer. Computed results were compared with experimental tests and showed favourable agreement. Comparison was also made with results of a lumped element analysis, which comparison showed that unless wave effects were considered, conclusions regarding muffler attenuation in the high frequency ranges could be erroneous. The digital method possessed advantages over other analysis methods.

Use of Activated Charcoal to Decrease Odour and Odour Transfer in Domestic Refrigerators, by A. L. Brody, J. W. Thomas and L. M. Lafeber, Whirlpool Corporation, St. Joseph, Michigan. When granular-activated coconut charcoal was used, said the authors, both odour and odour transfer between foods were reduced. Best results came when the charcoal was placed in the path of forced air for cooling, but when placed outside the forced-air path and when used in a refrigerator without forced air, results were superior to control cabinets which made no use of charcoal.

Solar Heat Gain Factors for Windows with Drapes, by N. Ozisik and L. F. Schutrum, A.S.H.R.A.E. Research Laboratory, Cleveland, Ohio. This paper covered a laboratory investigation of window drapes of several types and colours when subjected to solar radiation. An equation was presented whereby the total heat transferred through glass and drape could be calculated. Overall transfer coefficients for drape and glass combinations were given along with an example of how the information could be applied.

Fourth Technical Session

Alaska Summer Weather Data, by Robert Burggraaf, Harmon & Beckett, Inc., Denver, Colo. Outside summer psychrometric design conditions for the three principal Alaskan cities (Anchorage, Fairbanks, Juneau) were examined in accordance with suggestions of the T.A.C. on Weather Data. This information was tabulated over the period of record from 1950 to 1955. In order to calculate summer solar gains in the latitude of the Alaskan cities, solar gain values for 60 and 65 degrees North Latitude were established and included.

A Rational Method of Determining Summer Weather Design Data, by H. C. S. Thom, U.S. Weather Bureau, Washington, D.C. This paper included a demonstration showing that separate establishment of design wet- and dry-bulb temperatures yielded the same probability as if the values were set on a combined basis. A weather design variable which effectively limited the risk of failure between cooling seasons as well as within a cooling season was outlined. The methods were illustrated by application to Philadelphia and St. Louis. Winter and summer risks were shown to be nearly the same. New design values for eight cities were included, based on this rational method of approach.

Sensation Responses to Temperature and Humidity Under Still Air Conditions in the Comfort Range, by Walter Koch, M.D., B. H. Jennings and C. M. Humphreys, A.S.H.R.A.E. Research Laboratory, Cleveland, Ohio. This, the second paper from the environment studies at the laboratory, explained that subjects were normally clothed, at rest, and responses were after approximately three hours' stay in the environment with still air and with room surfaces at air temperature. Tests were conducted over a range of temperatures from 68° to 94° F. with relative humidities from 20 to 90 per cent. The optimum temperature was plotted as a nearly straight line and ranged from 77·6° F. at 30 per cent. humidity to 76·5° F. at 85 per cent. humidity, being only slightly dependent on humidity.

Proposed Humidity Standard, by C. E. Till and G. O. Handegord, National Research Council of Canada. This paper discussed the nature of the problems of calibrating humidity sensing devices and concluded that a means of producing a saturated atmosphere as needed was by the recirculation of moist air over a water or ice surface in a closed system. Such a device was constructed and its performance studied. Since good accuracy was obtained, it was suggested that the device could be used as a standard for calibration.

Domestic Refrigerator Engineering Symposium

Should Plastics be Used in Refrigerators ? was the topic of the session, with H. P. Harle, General Electric Co., as chairman. Plastic materials had been long used in domestic refrigerators with both good and poor results. Two papers were presented by representatives of the Society of the Plastics Industry as follows :—

Realistic Properties of Plastics Materials Applied to the Requirements of the Refrigeration Industry, by W. E. Brown, Dow Chemical Company. The author discussed properties of a full range of thermosetting and thermoplastic materials including strength as affected by temperature, long time strength, stability under load, heat distortion load, chemical resistance and odours.

Assurance of Satisfactory Performance of Plastics Parts in Refrigeration, by Dale Amos, Amos-Thompson Corp. This paper stressed the importance of careful blending and processing during manufacture of plastic parts, of testing for quality maintenance, and of the use of proper forming techniques.

Air-conditioning Symposium

Engineering Responsibilities was the subject of this session over which W. R. Moll, Whirlpool Corporation presided as chairman. Four papers were included in the programme :—

Engineering for Engineering's Sake ? by P. M. Augenstein, Chrysler Corporation, Dayton, Ohio. The author called attention to the point that engineering should not be regarded as an end in itself but as a part of an integrated, co-operative whole. The final design must result in a product balanced to suit the customer.

Creative Engineering—Key to Market Leadership, by Austin

Continued on page 403

The Institute of Refrigeration Bulletin

Institute Headquarters: New Bridge Street House, New Bridge St., London, E.C.4 (CENTral 4694)

MAY MEETING

A JOINT meeting of the Institute and the Institution of Heating and Ventilating Engineers will be held on Thursday, May 5, 1960, at 5.30 p.m., in the Memorial Building of the Institute of Marine Engineers, 76 Mark Lane, London, E.C.3. At this meeting, Mr. B. A. Phillimore, B.SC., Associate Member, and Mr. S. J. Jones, B.SC., will read a paper entitled "The Demand for Cooling in the Modern Passenger Liner."

The paper examines the problems involved in the design and installation of air-conditioning equipment and the associated refrigerating machinery for a large passenger vessel to be employed on the U.K.-Australasia service, and will consider the assessment of the air-conditioning demand of the various sections of the vessel. The selection of the refrigerating machinery, with regard to type and number of units, will also be considered, together with the features of the plant, arrangement, and the variations in air-conditioning demand over the voyage, which, may lead to interconnexion with the cargo and provision chamber refrigerating machinery installation.

The Presidency

It is with much pleasure that the Members of Council announce that Engineer-Commander W. R. Sinclair, R.A.N. (ret'd), B.ENG., has accepted their invitation to be President of the Institute for the year commencing March 26, 1960. Commander Sinclair has been a member of the Institute since 1931 and it is twenty-five years since he was first elected a Member of Council.

Honorary Treasurer

At a recent meeting of the Executive Council, Mr. T. A. Raymond was re-elected Honorary Treasurer of the Institute for the year March 26, 1960, to March 25, 1961.

Executive Council Election

Mr. K. J. R. Cocke, Mr. W. B. Gosney and Mr. R. W. Griffin, Corporate Members, and Mr. K. R. Billings, Companion, have been elected to fill the vacancies on the Executive Council caused by the retirement, under by-law 10, of Mr. J. Douglas, Mr. K. C. Hales and Mr. H. R. Howells, Corporate Members, and Mr. R. H. R. Lloyd, Companion.

THE EXECUTIVE COUNCIL, 1960-61
March 26, 1960 to March 25, 1961

President

Engineer-Commander Walter Robert Sinclair, R.A.N. (ret'd), B.Eng.

Past Presidents

Sir Rupert De la Bère, Bart., K.C.V.O.
Lieutenant-Colonel Lord Dudley Gordon, D.S.O., LL.D.
Sir Charles G. Darwin, K.B.E., M.C., SC.D., F.R.S.

Vice-Presidents

Charles Maurice Brain.
Stanley Fabes Dorey, C.B.E., D.SC., F.R.S., WH.EX.
William Stoddart Douglas, B.SC.
Edward Frederick Farrow.
Kenneth Lightfoot, O.B.E.
Henry Randal Steward, T.D., B.SC. (Eng).

Elected Members of Council

Kenneth Reginald Billinge.
George Leslie Harper Bird, B.SC. (Eng).
James Arnold Brewster.
Ernest William Burman.
Kenneth John Rallings Cocke, B.SC. (Eng).
John Carter Fidler, O.B.E., B.SC., PH.D.
William Bell Gosney, B.SC. (Eng).
Raymond Walter Griffin, B.SC. (Eng).
Elliott Morley Heap, M.Eng.
Godfrey Yate Pitts, M.Eng.
John Archer Stonebanks.
James Charles Taylor.
Thomas Telfer, B.SC. (Eng).

AMERICAN PLUMBING, HEATING AND COOLING EXPOSITION

A special tour for executives of the plumbing, heating and refrigeration industries has been arranged by Ashton & Mitchell Travel Ltd., in connexion with the American Plumbing, Heating and Cooling Exposition, to be held in Cleveland from June 20 to 23, 1960.

The tour, which will leave London on Saturday, June 11, and return from New York on Saturday, June 25, includes visits to a number of factories and installations.

The price of the tour will £375, with a supplement of £20 for single room throughout the tour. The air tickets will be available for individual return later than June 25 if required.

Full details of the tour may be obtained from Mr. D. J. Lloyd Davies, Ashton and Mitchell Travel Ltd., 55 St. James's Street, London, S.W.1.

SUMMER SCHOOL ON COLOUR TECHNOLOGY

A Summer School on Colour Technology is to be held at the Battersea College of Technology from June 20 to 24, 1960.

CONFERENCE ON FRUIT STORES

AN all-day meeting of The Institute of Refrigeration on the construction of cold stores for fruit was held at Ditton Laboratory, Larkfield, Kent, on Wednesday, March 16, 1960.

Members and visitors were received by Dr. R. G. Tomkins, M.A., superintendent, Ditton Laboratory, and Dr. J. C. Fidler, O.B.E., B.SC., officer-in-charge, Covent Garden Laboratory.

A symposium, comprising four papers, was presented by Dr. Fidler, Mr. G. Mann, Mr. E. S. Green and Mr. A. C. Murdoch, B.SC.

Dealing with biological aspects, in opening the session, Dr. Fidler declared :—

"The primary requirement of a store for fruit is that it should be capable of rapid reduction of temperature. The more perishable the produce, the better must be the performance. But even for apples, which may be kept for some months at ordinary winter temperatures, rapid reduction in temperature is essential for maximum storage life.

"A reasonable target for an apple store is to reduce the day's loading to under 45° F. overnight, and the whole load to 38° F. in two days after completion of loading. The performance on pears needs to be better than this, reducing to below 40° F. overnight and to 30° F. in air (or 34° F. in gas) in two days after sealing the store.

"Since an early build-up of carbon dioxide is necessary in gas storage, and since 45° F. is not a low enough temperature, the size of the day's loading determines the sizes of the store. It should not take more than four days to fill a gas store, or six days for ordinary cold storage.

"Pears should be stored the day they are picked, and apples within 24 hours.

"We now attach less importance than hitherto to the mixing of varieties. So long as the apples are normally picked at the same time and will tolerate the same temperatures and gas mixtures, we no longer regard separate stores as essential.

"However, we are giving more emphasis to atmospheres with low oxygen content, and even to conditions where the carbon dioxide is removed completely and oxygen reduced to about 2½ per cent. Such conditions demand efficient scrubbers, very efficient gas sealing, and more accurate estimation of oxygen content.

"The trend, encouraged by the Ditton Laboratory, away from storage of pears at 34° F. towards storage at 30° F., demands greater efficiency in coolers and air distribution systems, closer control of temperature, safety devices to prevent delivery air falling below 28½° F., and more efficient insulation.

"The following table summarises our current recommendations for storage of apples and pears, following speakers will deal with economic means of attaining these conditions."

Mr. G. Mann, in his paper on "Building and Engineering Requirements," said : "The uses of refrigeration are diverse, and refrigeration engineering is no less complex than other branches of applied engineering. Today we are concerned with the application of refrigeration to the storage of fresh fruit and vegetables. Growers spend time, money and energy on producing crops and they often wish to preserve them in as fresh a condition as possible, for as long as possible, and to do this they need cold stores and often other means of using refrigeration.

Insulation

"So much has been written about thermal insulation, its properties and methods of testing, that any discussion by me might be considered superfluous. I would, however like to comment on one or two points which specifically concern stores for fresh fruit and vegetables. First, I suggest that the 'U' value for walls and roof should be not more than 0·07, and for the floor 0·16, figures which may be considered uneconomic, the savings in power being less than the increased insulation costs. However, this high standard of insulation is suggested not only for the savings in refrigeration but also the more important considerations of the reduction in temperature variations and the maintenance of a higher humidity in the storage space. In estimating the amount of insulation required for a cold store it must be remembered that the 'k' values quoted in various references for materials are generally minimum values as obtained by the horizontal hot plate test. In practice, it is necessary to allow for imperfections in erection, solar radiation, and in some cases (where a loose fill is used) for possible convective air movement within the insulation. Lorentzen has shown that a vertical loose fill insulation tested when packed to a density of 6 lb. per c.ft. had a 'k' value about 30 per cent. higher than the figure obtained when tested by the horizental guard ring hot plate method.

"Data on the overall heat leakage has been obtained on four external store blocks each of two 50-ton stores. The heat leakage figures were in all cases higher than calculated. The basis of calculation of the 'U' value (using published data for 'k' values) was the usual textbook method with the temperature difference of warm side (ambient) air to store air. The actual percentages by which the actual heat leakage exceeded the calculated were :

		per cent.
50-ton stores granulated cork insulated	...	55
50-ton stores cork board insulated ...	...	28
50-ton stores foamed concrete insulated	...	50
50-ton stores cork board insulated ...	...	35

"These figures would be reduced if an allowance could be made for solar radiation. During the tests, with ambient air at 68° F., south wall and roof surface temperatures of 98° F. were observed.

"*Vapour sealing* of the insulation is important in some instances it may be considered superfluous but as there is always an element of doubt, is it not better to play for safety and put an efficient seal ?

"The insulation value, 'k,' of the cork prior to pouring the concrete was 0·32, the density being 7·6 c.ft. per lb. with a moisture content averaging 4 per cent. Three days after pouring the concrete the 'k' value was 0·37. Further measurements taken after 13 months and 27 months showed 'k' values of 0·39 and 0·46 respectively. The cold store temperature was 36° F. throughout the period

"*Gas Proofing*. If the stores are to be used for storage in other than normal air, it is necessary to provide a lining which is impermeable to CO_2 and O_2, on the interior surfaces of the store. There are two possible methods of doing this. One is to fix overlapping metal sheets to the surfaces, the other is to render with a suitable bituminous compound. The use of metal sheets has the disadvantage that wooden grounds have to be provided for fixing the metal sheets. Wood buried in the insulation is not a desirable feature. In applying a bituminous rendering, it should be done in two layers, allowing the first to dry out before applying the second. After completion, a test should be made to ascertain the efficiency of the sealing. CO_2 concentration possible in a store for different 'gas efficiencies.'

"In an efficient gas store (0·95) in which Cox's Orange Pippin apples are being stored, the CO_2 concentration should

be at the desired level of 5 per cent. in about five days. Scrubbing is then commenced, and the necessary low O_2 level should be achieved in a further 4 to 5 days.

Fans and Air Distribution

" For the successful storage of fresh fruit and vegetables, it is universally agreed that forced circulation of the cooling air is necessary. The stored produce is continuously producing heat and this heat has to be removed by circulating cool air within the stow which, in turn, gives up the heat gained to surfaces cooled by refrigerant. We thus have two heat transfer processes—from the produce to the air and from air to cooler. The rate of heat exchange will obviously depend on whether the fruit is freely exposed to the cooling air or whether it is in packages, where heat transfer is limited to conduction through the walls of the package. The amount of air circulating is, therefore, important, too much is expensive in fan power ; too little, and the necessary heat extraction will not be accomplished without a big temperature difference between produce and air. At what rate should the air be circulated ? In charting the effect of air velocity or change rate on the rate of heat transfer from produce packed in one bushel boxes, it will be seen that for an apple store with the temperature steady and the fruit giving off heat at about 40 B.t.u. per ton per hour, the necessary heat exchange may be effected with an air change rate of about 40 per hour, and only about 0·5° F. temperature difference between produce and air. This is a reasonable temperature difference. If the air change rate were to be reduced to 30 per hour, the temperature difference would need to be increased ; on the other hand, an increase of air change rate to 50 per hour would mean the fan power would be almost doubled. Fans may, with advantage, be fitted with two speed motors, operating at full speed when the refrigerating plant is running, and at half speed when the refrigerating plant is " off." This will effect a saving in power ; it will also reduce heat input to the store and increase the store humidity. Where fans operate continuously at full speed, the power requirements of the fans have been observed to be 65 per cent. of the total supplied to the plant. The question is often asked whether fans should be reversible ; it helps if they are, though the air distribution system is seldom equally efficient in both directions. The main benefit of reversible fans is when first cooling down the produce and temperature gradients may, by periodically reversed air flow, be evened out. Having once cooled down, there is no great

CONDITIONS FOR STORAGE OF APPLES AND PEARS (Dr. J. C. Fidler's Paper)

Variety	Storage in air °F.	Storage in Gas: without using scrubber °F.	without using scrubber $\%CO_2$	with a scrubber °F.	with a scrubber $\%CO_2$	with a scrubber $\%O_2$	Notes
1. *Cooking apples*							
Newton Wonder, Annie Elizabeth	34	—	—	—	—	—	Store in air only.
Monarch	33—34	33—34	7—8	33—34	5	3	
Bramley's Seedling, Lord Derby, Stirling Castle, Edward VII, Lane's Prince Albert, Howgate Wonder	37—39	38—39	8—10	—	—	—	Adequate storage period without using scrubber.
Crawley Beauty	38—39	—	—	—	—	—	Store in air only.
2. *Dessert apples*							
Worcester Pearmain	32—34	33—34	7—8	33—34	5	3	Adequate storage period without using scrubber. High humidity essential.
Lord Lambourne, Ingrid Marie, Winston	35—38	35—38	6—8	—	—	—	No experience using scrubber, but probably safe in 5% CO_2 : 3% O_2.
Laxton's Superb	35—38	35—38	6—8	37—38	7—8	3	
Cox's Orange Pippin, Ellison's Orange	38—39	38—39	6	38—39	5	3	Scrubbed gas storage advisable.
Laxton's Fortune, Bowden's Seedling, Sunset, Egremont Russet, Michaelmas Red, Merton Worcester	37—38	37—38	7—8	—	—	—	No experience with scrubber but probably safe in 5% CO_2 : 3% O_2.
Allington Pippin	36—37	37—38	7—8	—	—	—	
Barnack Beauty	36—39	—	—	—	—	—	Store in air only
Blenheim Orange, King Pippin	40	—	—	—	—	—	Store in air only
Jonathan	40	40	7—8	—	—	—	No experience with scrubber.
3. *Pears*							
All early varieties	29—34	—	—	—	—	—	Do not gas store pears if advanced maturity suspected. For storage in air, temperature of air off cooler not to fall below 29° F.
Williams B.C.	29—30	33—34	6	33—34	6	5	Do not gas store pears if advanced maturity suspected. For storage in air, temperature of air off cooler not to fall below 29° F.
Conference	29—30	33—34	6	33—34	6	5	Do not gas store pears if advanced maturity suspected. For storage in air, temperature of air off cooler not to fall below 29° F.
Comice	29—30	33—34	6	33—34	6	5	Do not gas store pears if advanced maturity suspected. For storage in air, temperature of air off cooler not to fall below 29° F.
Bristol Cross, Laxton's Superb	29—30	—	—	—	—	—	Store in air only.
All other late varieties	29—30	—	—	—	—	—	Adequate storage life in air at 29°–30°F. (Packham Triumph can be stored in 7% CO_2).

advantage in reversing the fans if the arrangements for distributing the air are good.

"The necessity for uniform air distribution throughout the produce is very important. The fruit is self-heating and, therefore, if undesirable temperature variations are to be avoided, each box must receive the same quantity of cool air.

"In our experience, the only satisfactory way of achieving this uniformity is by the use of roof air ducts which deliver air to the stack, and with a floor suction plenum from which air is drawn and passed over the cooler."

The following table shows temperatures taken in spaces with different air circulating arrangements.

Space	Capacity	Mean del. air temp.	Max. temp.	Min. temp.	Mean devn.
100-ton 2 Central Coolers	5,000 boxes	38·6	41·3	38·7	0·38
16-ton 3-Unit Coolers End wall No ducts	800 boxes	33·0	38·6	33·2	—
50-ton Central Cooler	2,500	38·6	39·7	38·9	0·5
50-ton Central Cooler	2,500	37·5	*41·7	37·8	0·6
Ships cargo Space 1937 Roof del. wing suction	48,000	33·8	36·3	34·1	0·30

*Warm zone confined to a small block near the door. When store opened it was found that a section of dunnage was wrongly positioned.

Store Air Coolers

The choice of air cooler presents the biggest problem in the design of a store for fresh fruit and vegetables. A cooler unit should be of a size adequate to the maximum load but be compact; it should offer a minimum resistance to air flow over it, and when the produce is at the required optimum temperature, should absorb the heat load with a minimum difference in temperature between produce and air.

"A design of cooler, tested at this laboratory, which it appears would be satisfactory for apple or pear stores of 50 tons, had a staggered pipe arrangement with extended surfaces. The cross section in the direction of air flow was 3 ft. 6 in. by 3 ft. and the surface area was 700 sq. ft., made up of 100 sq. ft. of pipe surface plus 600 sq. ft. of extended surface (both sides being reckoned). Time does not permit a detailed discussion of the results, but briefly, when tested with an approach air velocity of 4 ft. per second (max. v. between pipes 13 ft. per sec.), the over-all heat transfer was 5·6 B.t.u. per sq. ft. per hour per °F. mean refrigerant to mean air. The pressure drop of the air over the cooler was 0·11 in. w.g.

"Control of refrigerant temperature can be obtained by the use of back pressure valves, compressor capacity control or other means. The uniform distribution of air over the cooler is as important as uniform distribution through the produce.

"Defrosting arrangements are essential, particularly during the produce cooling down period. Fig. 7 shows how the cooler performance can deteriorate with frosting; these curves were obtained during one of our experimental cooler runs.

Plant

"The refrigeration units for fresh fruit and vegetables are usually of the direct expansion type. Generally it is only for installations of 600 tons and upwards that the use of a secondary refrigerant is economical. The duty of a refrigerating unit for this type of work has to cover the wide range of 5 or 6 to 1; a heavy heat load when cooling down a store filled with warm, newly harvested produce and the very much lighter load when holding at the required temperature. The plant must be designed for the heavier load, as it is important to bring the produce temperature down to the optimum for storage as quickly as possible. The maximum heat load depends on the initial produce temperature and the maximum rate of loading the store. In this connexion it may be advantageous to allow a margin, as often the anticipated rate of store loading can be exceeded due to extra acreage coming into bearing or heavy crops. It seems reasonable to install a 4 h.p. unit for a 2,500 bushel (50-ton) store, to allow a little margin. A 2,500 bushel store for pears at 30° F. will require a unit of about 5 h.p.

"It is important that if air cooled, the plant should be sited where it may operate at maximum efficiency—where it can receive an unrestricted supply of the coolest air available.

Control of the Concentration of CO_2 and O_2 in Fruit Stores Using Fresh Hydrated Lime for CO_2 Absorption

"Some varieties of fruit retain their quality better when stored in an artificial atmosphere having a higher concentration of carbon dioxide and a lower concentration of oxygen than normal, *e.g.* Cox's Orange Pippin apples are best kept in an atmosphere of 4 per cent. CO_2, 2½ per cent. O_2 and 93½ per cent. N. and at a temperature of 37°-38° F.

"The method of obtaining this atmospheric composition is to allow the CO_2 to build up to the required level or a little above. Air from the store is then circulated in a closed circuit over a substance which absorbs CO_2. The carbon dioxide which is absorbed is replaced by an equal volume of air entering via the breather or ventilation pipe. As in respiration, the volume of oxygen absorbed from the storage atmosphere is replaced by an equal volume of CO_2 and as the CO_2 absorbed by the scrubber is replaced by air (a mixture of oxygen and nitrogen), the concentration of O_2 can, in time, be reduced to 2½ per cent. The extent of ventilation and scrubbing can then be adjusted to maintain the required concentrations of CO_2 and O_2.

Instrumentation

"Cold and "gas" stores for fruit and vegetables do not require elaborate instrumentation, but such instruments as are essential for the measurement of temperature, CO_2 and O_2, must be accurate and reliable.

Future Developments

"In Holland, a number of jacketed stores for fresh fruit and vegetables have been constructed; the storage space is a sheet metal structure inside an insulated space. Cool air is circulated in the air gap and heat from the produce is transmitted via the metal walls to the cool air. Cooling in this way means that the heat to be extracted from produce space is less by the amount of heat leakage and the space humidity is, therefore, materially increased. It is also claimed that an internal air circulation fan is unnecessary, convection alone providing sufficient air movement without large temperature gradients."

Mr. E. S. Green dealt with "Design considerations and the engineer, and after referring to early experiments carried out in 1898 and to a store built in 1913, said: "Since that store was erected we have benefited from research into the life cycle of the various varieties of fruit stored under various conditions. This research started in the Low Temperature Research Station at Cambridge and has since been continued here at Ditton, and our thanks are due to those who have so patiently carried out this work. I believe I am correct in saying the original line of thought was storage of apples, pears and probably plums. Since then it has developed not only into a study of each variety of apple, pear and plum, but on the type of soil upon which it is grown, and the manner of its cultivation before storage and the length of storage life required.

(Extracts from Mr. Green's and Mr. Murdoch's papers will be given next month.)

REFRIGERATED CABINETS

"SHOP WINDOW" FOR DENMARK

DANISH meat and dairy products, which are already imported into Britain in very large quantities, are likely to become even more popular as the result of the opening last week of the Danish Centre, in Conduit Street, London, where the public will be able to see, taste and buy examples of the most appetizing ways of preparing these foods. The Centre is a "shop window" for the whole of the Danish agricultural industry, which employs one-fifth of Denmark's population and produces two-thirds of all her exports.

Members of the trade and the general public can see at the Centre, bacon, ham, cheese, eggs, butter and fresh fruit and vegetables, and they can also watch them being converted into colourful and tasty dishes which may be bought over the counter or eaten in the small restaurant section.

The "meal-in-itself" Danish open sandwich, which is a spectacular feature of the displays and demonstrations, must be kept perfectly fresh for eating, and specially designed showcases have been installed for them, with refrigeration by Frigidaire.

R. E. A. Bott (Wigmore Street) Ltd., Frigidaire distributors for Central London, have designed and installed these cases and all of the refrigeration used at the Centre. Three of the special sandwich cases have been built, with refrigeration to a gentle 50° F., for the short period between building the sandwiches and selling them to customers to take home or eat on the premises. For display of groceries and bacon there are also two Frigidaire three-tier display cases in the showroom and milk for the restaurant section is held in a special 40° F. storage cabinet.

In the modern kitchen where Danish ham, bacon, eggs, butter and milk will be constantly converted into appetizing dishes, there is a 20 c.ft. refrigerated storage cabinet for perishables. A 3.4 c.ft. Frigidaire domestic refrigerator and an ice cream and frozen food conservator are also installed.

Bulk storage in the basement includes a 100 c.ft. 32-34° F. Frigidaire meat cabinet, equipped with Frostmaster automatic electric defrosting and a similar sized cabinet for fruit and vegetables, operating 40-45° F.

The refrigerated showroom cases are equipped with flexible refrigerant lines so that they can be moved aside to allow more space for larger demonstrations. The main sources of refrigeration power are six Frigidaire air-cooled condensers housed outside the rear of the premises.

Prestcold at Glasgow Exhibition

A wide range of refrigeration equipment will be shown by the Prestcold Division of the Pressed Steel Company, Limited, at Scotland's Food Exhibition to be held at the Kelvin Hall, Glasgow from April 19 to 30. Models will include the Automatic Nine, the Packaway, the New Big Four, the Farmoor, the Retailer, the Vendor, the Multi-deck display case, the Three-Quarter View display case, the Serveover, the Kintyre, and the recently introduced Caterer.

"Period" Styled Cabinets

FORTNUM AND MASON of Piccadilly have recently opened a new provisions department. The problem they faced was the installation of equipment which would be in keeping with 250-year-old "period" atmosphere of the establishment.

Frigidaire were approached and their Central London distributors, R. E. A. Bott (Wigmore Street) Limited, co-operated with craftsmen to effect a compromise. Oak panelled units were produced combining the latest techniques in food cooling with attractive woodwork.

Basically, all of the display cases are McCray cabinets with Frigidaire cooling equipment operated from a range of water-cooled condensing units installed in the basement. First quality oak was selected for their finish and cut to ensure the least possible shrinkage. The oak was worked by the shopfitting and joinery manufacturing firm of Borman and Perkins, being made up in a bleached and limed finish.

The equipment comprises a 14 ft. case for the display of poultry and game cooled to 36° to 38°F., a 16 ft. counter for cheese and dairy produce, and another 18 ft. 6 in. counter for delicatessen, both operating at 38° to 40°F., and two island sited display cases.

The first of these is a unique and very attractive frozen food and ice cream display and self selection case, in the shape of a letter "L" with a total length of 13 ft. of display. The Frigidaire equipment installed in this case is capable of maintaining a temperature of -20°F. The second island display unit is used for varied products, having a cooled top 14 ft. by 6 ft. in area. Underneath is about 150 c.ft. of storage space at 40° to 45°F.

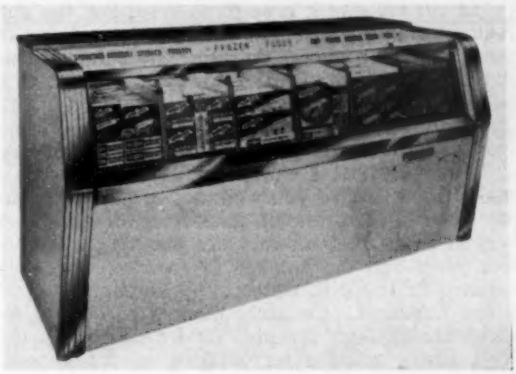
The cheese and dairy and delicatessen counters are backed up by 13 ft. 6 in. of storage space at 40° to 45°F. with sliding doors, and there is also a new built-in cold room of 1,250 c.ft. capacity with a Frigidaire forced air evaporator. The walls of the provision department are also in solid oak, alternate panels having been carved in bas relief and picked out with gold leaf to illustrate famous London landmarks, including Nelson's Column, Eros in Piccadilly Circus and Westminster Abbey.

[J. & E. Hall Limited]

On page 151 in our February issue we reproduced an illustration and a description of centrifugal compressor sets manufactured by Associated Electrical Industries (Rugby) Limited. J. & E. Hall Limited have asked us to point out that these compressor sets were all supplied to their order as part of complete refrigerating plants for air-conditioning installed by them in the ships mentioned in the paragraph.

New Frigidaire Cabinet

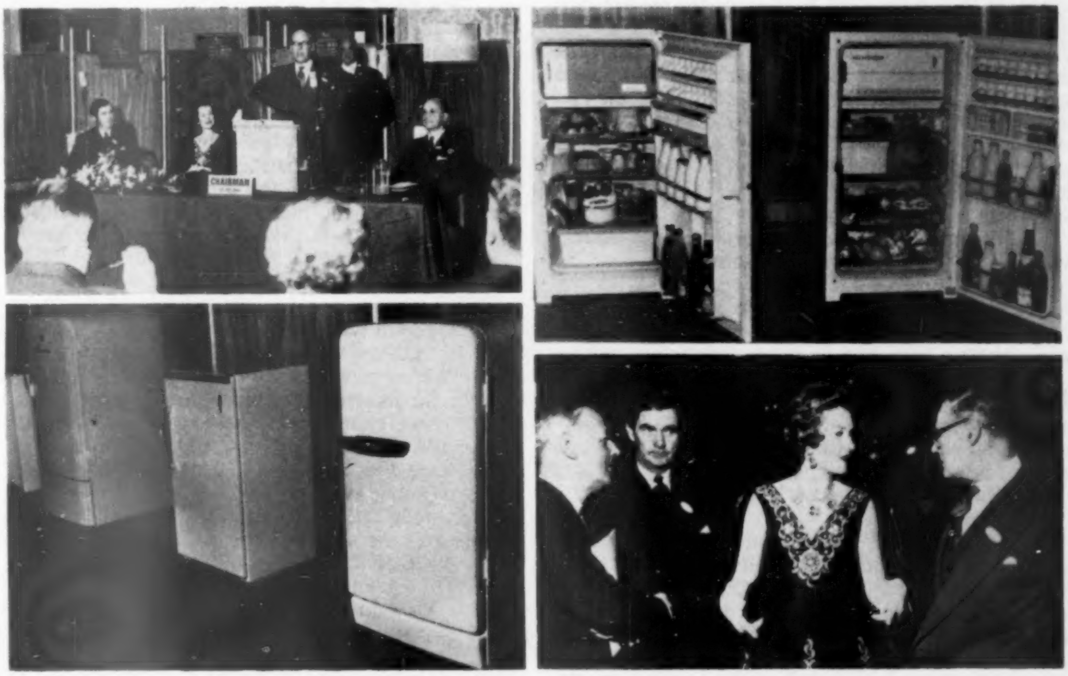
The range of Frigidaire-cooled low temperature sales cases has been extended by the introduction of the AGF-136. Its size makes it suitable for the smaller trader anxious to progress from open-top conservator to a cabinet with up-to-the-minute features of sales appeal. At the same time its capacity of 13.6 c.ft. combined with convenient outside dimensions make the AGF-136 suitable for all stores, either individually or in multiples. Frozen food packets are displayed in six compartments between dividing evaporator plates and there is also storage space below the display line for half the length of the cabinet. Refrigeration is maintained throughout the storage and display space to a temperature of 5°F or below. Attractively finished in zinc-coated mild steel panels finished in white enamel, with polished stainless steel on edges and around the glass, the cabinet is styled for easy access at hip-height. The glass front is in four thicknesses with three sealed cavities for minimising misting, and to prevent condensation low voltage heater cables are fitted to the front glass surround. A fluorescent tube lights the interior and also illuminates the "frozen food" sign. An unrefrigerated merchandiser display top, giving three shelves, is available as an extra. The condensing unit is a $\frac{1}{2}$-horsepower Frigidaire air-cooled unit installed integrally in the cabinet with a removable louvred panel giving easy access from the front. The motor



is fully automatic, self-starting and self-stopping and is warranted for five years. The overall size of the AGF-136 is 6 ft. $2\frac{1}{8}$ in. long, 30 in. wide and $37\frac{1}{4}$ in. high.

TOP TEN SHOW

Mr. M. Craig opened the Top Ten Show, organized by the Domestic Refrigeration Development Committee, at the Café Royal, London, recently. On his right is seen Viscountess Lewisham, guest of honour. On Mr. Craig's left is Mr. K. J. R. Cocke. In the lower right-hand illustration, Viscountess Lewisham chats with Mr. Craig; Mr. H. C. Timewell and Mr. Claude C. J. Simmonds are on the left.



B.R.A. LUNCHEON

(*continued from page 376*)

tion not only in the overseas markets but, nowadays, in the home market as well as a result of greater freedom of imports from Europe and elsewhere.

"In our industry it is up to us to see that the same requirements are met and in addition that our exports to these countries do rather more than balance our imports from them. However, we thrive on competition and we face the future with confidence, but without complacency."

Replying for the guests Mr. J. R. Parratt said: "I imagine that I would not have been asked to make this speech if you were not prepared to suffer my views on the future of quick-frozen foods and the way in which your industry can play its part. Some five years ago the number of frozen food display cabinets in shops in this country amounted to only a few hundreds. Certainly there were quite a few coffin-like cabinets designed for ice cream, but they were hardly suitable for bringing to the attention of the public the exciting and widening range of frozen foods in packages designed to titillate the palate. I well remember how difficult it was at that time to convince many people of the tremendous growth potential of quick-frozen foods and how slowly and reluctantly some adapted their minds and their equipment for the revolution to come. In those five years the sales of retail packs of quick-frozen foods in this country has multiplied some 7½ times, reaching around £36 million last year. Over one-third of this turnover came from products which were not on the market at all five years ago.

"One cannot expect the same percentage rate of expansion to continue but in view of the tremendous advantages which quick-frozen foods offer to the British housewife, I can see no reason to suppose that there will be anything other than continued rapid expansion for many years to come. When you consider that in the United States of America quick-frozen foods represent around 5 per cent. of the total food sales, whereas in this country we are only just coming up to 1 per cent., you will have a clearer idea of the fantastic prospects that lie ahead.

"Well so much for the prospects, but prospects are one thing and realisation another. It may be that the first stage of our rocket is beginning to tail off but have we perhaps a second stage which can now come in? Let us look at what has happened. Quick freezers have had immense help from makers of industrial refrigeration equipment and have been able to build up production and storage techniques the equal of anything in the world. But in the commercial refrigeration field they have had to battle against the virtual absence of suitable refrigeration in the home and until recently the virtual absence of shop display cabinets.

"How do we ensure that the public goes on buying ever-increasing quantities of quick-frozen foods? Now you know that the processor takes immense trouble to make sure his product is at its peak at the time when he freezes it. What happens after that depends upon the proper maintenance of the necessary low temperature. First the product meets the hazard of transportation and here we can do with considerable improvements in refrigerated transport. Any rise above zero during delivery makes the situation in the retailer's cabinet even worse than it is any way, for it is here that much of the mishandling of quick-frozen foods takes place. Those who have distributed frozen foods and those who have sold the equipment are, I think, jointy responsible for having failed to educate the trade and the public on the vital importance of temperature maintenance. Not only do many retailers have no conception of the importance of this temperature maintenance but many of those who sell them the equipment and those who service it are, I am afraid, often either ignorant or wilfully neglectful of the temperature needs of quick-frozen foods. One still finds instances of shopkeepers who turn off their cabinets at night to save current, and of others who pile goods above the load line—and while we are on this subject, I believe there are actually manufacturers who still produce cabinets without a load line marked on them. Worse still, some existing cabinets are, I believe incapable of maintaining a suitable temperature. Random checks made in various parts of the country recently showed that the average product temperature in one in seven cabinets was above 10°F. and in one or two cases above 20°F.

"Well gentlemen, so much for the present situation, but what more difficulties are to come? Just think of the further hazards to the quality of our products as more and more of the general public acquire their own refrigerators. If a housewife does not understand the needs of frozen foods she will happily carry her purchase around for an hour or two before putting it into her frozen food locker.

"We must not lose sight of the fact that the public at large thinks that freezing is freezing and that there is nothing below it. Therefore, so long as ice can be seen they think that a thing is satisfactorily frozen and will keep indefinitely. What some manufacturers call a frozen food locker is suitable for no more than three days storage whereas others can be used for very much more lengthy periods. How can we expect the ordinary woman in the street to understand this unless we all get together and set about using the same terms and educating the public in the same way. We should draw a lesson from the troubles that America has run into on the score of temperature.

"So gentlemen, what can we jointly do to ensure that we both take advantage of the opportunities that exist? In my view our two Associations must get together as a matter of urgency. They must first assess the hazards, they must then lay down standards related to temperature, storage periods, nomenclature and size and then they should jointly set about educating the trade and the general public. While this is going on I do implore all manufacturers to take a long term view and to look at their specifications and the descriptions of their equipment in the cold light of dawn.

"Well gentlemen, perhaps I have been blunt, but I felt I would be failing in my duty as your guest if I did not frankly state my views. If we can get these things right, I think we quick-freezers will be able to say to you, 'Give us the refrigerated space and we will get on with the job.' "

COMMERCIAL AND INDUSTRIAL SECTION

Manufacturers' and Distributors' News

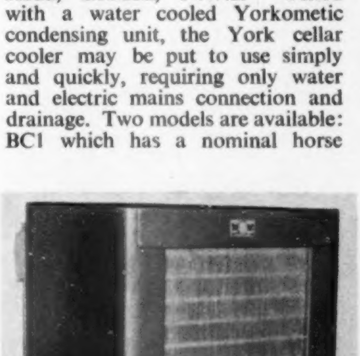
With conventional forms of gland seal as used widely in pumps, compressors, mixers, agitators and other rotary equipment, it is necessary to strip down the shaft when the wearing parts of the seal become due for replacement. To obviate this operation, **Flexibox Ltd.**, Nash Road, Trafford Park, Manchester, 17, has introduced a split mechanical seal. Replacement of worn parts only entails removing a few screws, taking out the old parts and inserting new ones. Precision manufacture of the components ensures a low leakage rate of the order of only a few c.c's per hour. The Sectaflex seal is a face-type mechanical seal in which sealing action is obtained by arranging for intimate contact between the rubbing surfaces of two assemblies, one of which is held stationary while the other rotates with the shaft. As these components are subject to wear they are each divided into two halves and assembled together in accurate alignment with the assistance of a solid locating ring. A third component, a flexible O-ring designed to prevent leakage along the shaft, is also split for ease of replacement. A unique feature of the design is the means adopted for ensuring that the rubbing faces are accurately aligned at right-angles to the shaft. This is effected by holding the stationary assembly firmly in a seal plate which is itself bolted to the stuffing box casing. Set screws in the seal plate itself then enable the relative position of the stationary assembly to be varied within fine limits.

* * *

A high-quality precision instrument the Defromatic, which has been developed by **Smiths Clocks & Watches Ltd.** and **Waldy (London) Ltd.** provides a fully automatic 24-hourly defrosting cycle for all domestic electrical refrigerators, of sizes varying from 2 c.ft. to 12 c.ft., which do not incorporate a fully automatic defrosting mechanism. This mechanism, which is sensitive to variations of temperature in the cabinet itself and not only on the surface of the evaporator, cuts of the electric current supply to the refrigerator motor for a period which is related to the size of the refrigerator and based on very considerable theoretical and empirical data. A micro-adjustment graduated in cubic feet is incorporated, which ensures the correct defrosting period for any size refrigerator. The Defromatic has been tested by the EDA for soundness and safety of mechanical and electrical construction.

* * *

An entirely self-contained portable beer cellar cooler is announced by **York Shipley Ltd.**, North Circular Road, London, N.W.2. Fitted with a water cooled Yorkometic condensing unit, the York cellar cooler may be put to use simply and quickly, requiring only water and electric mains connection and drainage. Two models are available: BC1 which has a nominal horse power of 1 and measures 23 in. by 33 in. by 48 in. high, and BC2 with a nominal horse power of 1½ and measures 28 in. by 33 in. by 50½ in. high. The system is flexible ; any number of coolers may be used according to requirements. Fitted on castors they may easily be moved to any section of the cellar where cooling is needed.



The York Shipley beer cellar cooler.

* * *

Mr. E. A. Howe, managing director of Film Cooling Towers (1925) Ltd., will shortly be leaving for a four weeks business tour of the Caribbean. He will be flying direct to Antiqua and expects to visit cooling tower installations in St. Kitts, Barbados, Jamaica and Trinidad.

* * *

R. A. Bennett & Co. Ltd. announces the appointment of **Mr. R. J. McGourley** as a full time representative. Mr. McGourley carries a van stock of miscellaneous components of all well-known makes. He is covering the Midland Counties on a regular fixed schedule which will be notified to all customers in due course. Fresh customers wishing to be included in this regular schedule are invited to inform the company at 24 Westway, Pelsall, Staffs ('phone : Pelsall 556).

* * *

One of the largest refrigeration firms in Southern England, **Central Distributors (Southern) Ltd.,** of Portsmouth, celebrated its 21st anniversary recently. The company was founded in 1939 by Mr. G. J. Horton with a staff of 15. Now the staff is five times that number and there is a fleet of over 40 vehicles supplying and servicing products of Frigidaire Division of General Motors Ltd. for whom the firm are distributors. Central Distributors (Southern) Ltd. design and install commercial refrigeration equipment and supply Frigidaire domestic appliances to the trade in Hampshire, Isle of Wight, West Sussex and parts of Surrey. They have a head office at 259 London Road, Portsmouth, and branches at Ryde, Guildford and Southampton. A celebration party was held at the Savoy Ballroom, Southsea, on the

17th when the guest of honour was the Deputy Lord Mayor of Portsmouth, Councillor Alfred Blake, in the absence of the Lord Mayor due to illness. Mr. Horton, managing director of the company, who is also a Portsmouth Councillor, presented to Councillor Blake a Frigidaire refrigerator and spin drier, which were then to be raffled, the proceeds being donated to the World Refugee Year Fund.

* * *

In conjunction with their U.K. agents, **Dean & Wood (London) Ltd.,** the **Danfoss Company** have recently been holding courses of lectures covering the application and installation of refrigeration controls. They were held at the Shaftesbury Hotel in London.

Under the supervision of Mr. C. Matthiesen, the technical director of Danfoss, the lectures were given by Mr. Ross-Jensen and Mr. H. Christensen, refrigeration engineers in the firm's technical department, and Mr. R. Steele, chief engineer of Dean & Wood ; they were attended by some 460 refrigeration engineers and servicemen from all parts of the country.

In all, six courses were held, each lasting two days. On the first day, members were given three illustrated lectures, one covering thermostatic expansion valves, another secondary automatic controls for refrigeration installations and the third solenoids, water valves, pressure switches and thermostats. These were followed by an evening of informal discussion.

On the second day the delegates joined in a "quiz" covering the previous day's work and were then shown illustrated examples of actual plants and installations, and the way in which their particular problems were solved. A farewell luncheon rounded off the proceedings.

Although similar courses have long been held at the offices of the Danfoss organization in Nordborg, this is the first time that such a project has been held in any other country. The interest and enthusiasm shown by those attending are sure indications of its success.

* * *

Ultra-clean assembly facilities, once thought of as only necessary for a few scientific purposes, are now so widely used in industry that the provision of suitable equipment has become a specialized branch of engineering. One company having good reason to be especially interested in this battle against dirt is **The British Manufactured Bearings Co. Ltd.,** of Crawley, who are producing miniature precision ball bearings with bore diameters down to 0·040 in., and weighing as little as 0·0038 oz. The importance of such minute precision components is in inverse proportion to their size, for in addition to their very considerable value for use in instrument, aircraft equipment and light industrial applications, they are tailor-made to meet the exacting requirements of the missile manufacturer. Among the early steps taken by B.M.B. in solving this problem of dirt in the manufacture of its bearings was the installation in clean atmospheres of pressurized assembly cabinets. B.M.B. began manufacturing cabinets for its own use, and, as both designers and users of the equipment, quickly accumulated a wealth of detailed knowledge on the finer points of design involved. This valuable experience and the success achieved in dealing with its own dirt problems led the company to form a new associate—John Bass Ltd.—to manufacture "Bassaire" pressurized assembly cabinets for sale to industry in general. These cabinets were recently inspected at Crawley by "M.R.'s" representative.

Two "M.R." photographs taken at the recent Danfoss course at the Shaftesbury Hotel, London.

* * *

A rigidly constructed, self-contained mobile bottle cooler of light appearance and compact design,

The Lightfoot bottle cooler.

provides the catering and licensed trades with an efficient means of serving cooled beverages at their most palatable temperatures. These **Lightfoot** coolers have been specially designed for installation where space limitations prevent the use of cabinets operated by remote condensing units or where speedy transport and erection of an efficient distribution point for cooled beer is required. This makes them eminently suitable for use at garden parties, race meetings and other sporting occasions or as temporary bars at dances etc. The units are adaptable to almost any site, backwall, undercounter or free standing etc.

* * *

Bylock Electric Ltd. announce that an arrangement has been entered into with the well-known organization of Alfred Teves of Frankfurt/Main to distribute their domestic appliance productions throughout the United Kingdom. The German firm's range of refrigerators, sold on the Continent under the brand "A.T.E." will be marketed in the U.K. as "Centurian."

Recently returned from Canada and the U.S.A. for refrigerators is Mr. C. R. Purley, chairman and joint managing director of **Lec Refrigeration Ltd., Bognor Regis.** During his 33-day trip Mr. Purley visited various manufacturers to study new methods and developments, attended a convention, and called on the company now building Lec compressors under licence in Canada. The most important feature resulting from his mission is his order book—nearly $250,000 worth of refrigerators to be delivered to the major centres of the United States and Canada over the next three months. For the first time Lec refrigerators, which have been selling in large numbers for some years in Canada, will corner a section of the U.S. market, where they will be used in flats, yachts, offices, motels, bars and trailers.

* * *

Onazote expanded rubber, manufactured by the **Expanded Rubber Co. Ltd.,** of Croydon, is being used to insulate pipework at the new plant of Palatine Dairies, Blackburn, recently acquired by the Milk Marketing Board. The material is being supplied in the form of pipe sections machined from standard sheet material.

* * *

Expandite Adhesives Ltd., a member of the Expandite group of companies, has been formed to manufacture and market a range of adhesives. The main emphasis will be on adhesives for the Building, Civil Engineering and Metal Fabrication and Assembly industries. The Company will develop and manufacture adhesives for special applications as required. The Company will operate from office and factory premises at Birchley Street, St. Helens, Lancashire (Telephone : St. Helens 7376/7 ; Telex 25420).

* * *

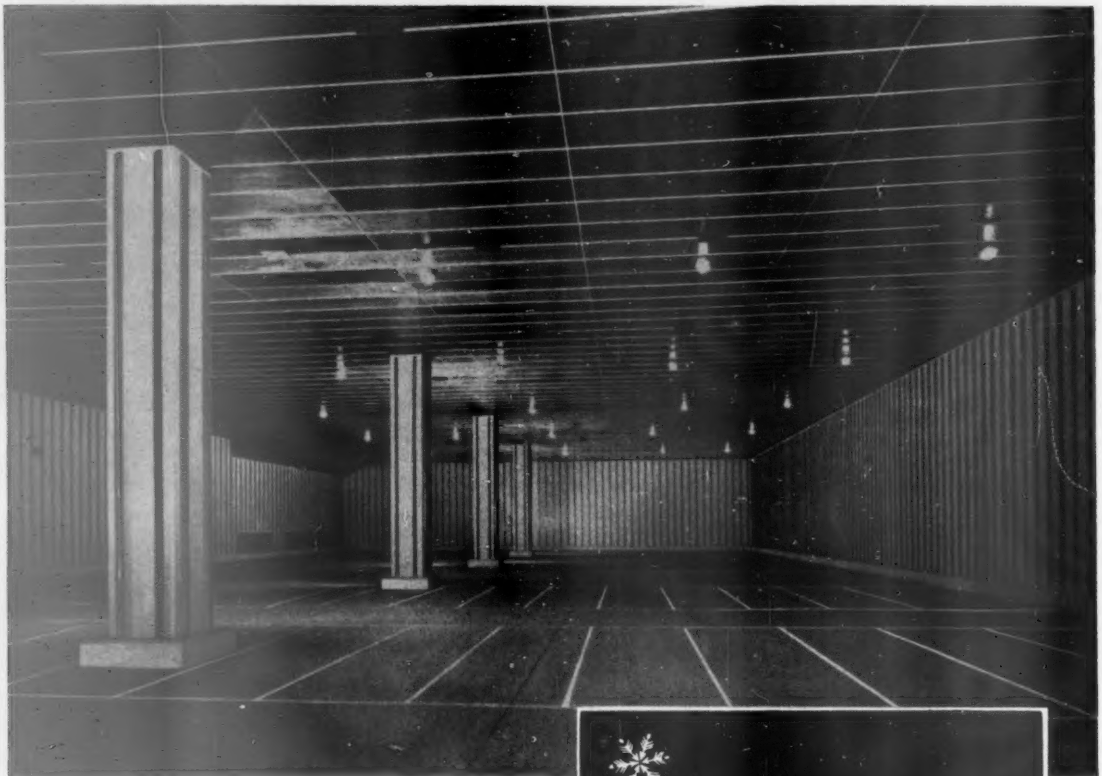
Work on a new extension to its Stroud factory is shortly to be commenced by **T. H. & J. Daniels Ltd.** The existing works site is now fully occupied with factory buildings and plans have been prepared for future development on the field at present used by the Rodborough Old Boys Football Club. It is intended to start work on the first phase of this development within the next few weeks. This phase will provide an additional 15,000 sq. ft. of factory space which will be mainly used for the assembly of plastics moulding equipment. For some years the company has found itself very restricted in regard to space and it has been necessary to sub-contract a good deal of work. The present extension will enable the company to effect a better layout for its assembly sections.

U.S. KELVINATOR'S CHIEF IN BRITAIN. This photograph was taken during the visit of Mr. George Romney to Kelvinator's Bromborough factory. He is president of American Motors Company, Kelvinator's parent company. From left to right: Mr. L. N. Griffiths, Mr. Hugh Cameron, Mr. Norman Saunders, Mr. George Romney, Mr. Eric Cohn, Mr. Gray Eden and Mr. Duncan Welch.

CONTROLS LECTURE—On February 18 and 25, a lecture on refrigeration controls was given by Mr. V. J. Lewis, assisted by Mr. H. Birnie, both of Teddington Refrigeration Controls Ltd., to service engineers, and Eastern Electricity Board Personnel attending a course at The Lightfoot Refrigeration Co. Ltd., Abbeydale Road, Wembley. The party were welcomed at Lightfoot Refrigeration by Mr. L. E. Steggel, service manager, Mr. A. Young and Mr. R. Fraser. The lectures dealt with theory and practice of various forms of expansion valves and thermostatic switches, and were followed by discussions on the problems likely to be encountered in application and service.

STUDENTS VISIT SUNBURY—Students from the National College of Heating, Ventilating, Refrigeration and Fan Engineering, accompanied by Mr. F. J. Hagger, lecturer in refrigeration, had a conducted tour round the works of Teddington Refrigeration Controls Ltd., at Sunbury-on-Thames, on March 2. The party included students from India, Kuwait and Portugal, and they had the opportunity of seeing at first hand the numerous operations associated with the manufacture of a wide range of instruments supplied to the refrigeration industry.

New Cold Store for STAMINA FOODS LTD., *St. Helens*



INSULATION by "J.D."

In specifying "J.D.", Stamina Foods Ltd. ensured that the insulation of their new cold store was to be carried out by a company whose wide experience and knowledge are a byword in the industry, extending over commercial, industrial and marine fields.

"J.D." have contracts for some of the most modern installations embodying all the latest technical improvements both in materials and methods of construction. Our technical advisory service is available at all times and estimates are given for either the traditional type of cold store or, if required, the modern method of envelope construction.

"J.D." Insulating Company Limited were entrusted with the insulation of this impressive new cold store by L. Sterne and Company Limited, the Architects being Messrs. Gornall, Kelly and Partners of Liverpool. An important factor in securing this order was speed of erection—just six weeks site time. The capacity of the cold store and cooler compartment is 150,000 cubic feet and the cold store will be maintained at a temperature of zero to minus 5° F.

An interesting feature is the false ceiling extending over the whole area and forming an air duct with air diffusers set in same. Specially manufactured metal air ducting was fitted connecting the false ceiling to the three air coolers.

SEAL OF EFFICIENCY J.D. TRADE MARK

"J.D." Insulating Co. Ltd.

Head Office : Hawthorne Road, Bootle, Liverpool, 20 *Tel. : Bootle 2205 (5 lines)*
Branches at.:—London, Glasgow, Newcastle and Southampton

Cold Store with Novel Features

USE OF FALSE CEILING AT ST. HELENS

IN the autumn of 1957 Stamina Foods Limited, St. Helens, Lancashire, brought into commission a new 50,000-c.ft. low-temperature store. Owing to a greatly increased volume of business this cold store had become inadequate and further cold storage facilities were required. Once again, the team which carried out the installation of the original cold store were called in for the construction of this new store, an important factor being speed of completion. The building work was completed in record time and the insulation of the cold store was achieved within six weeks' site time.

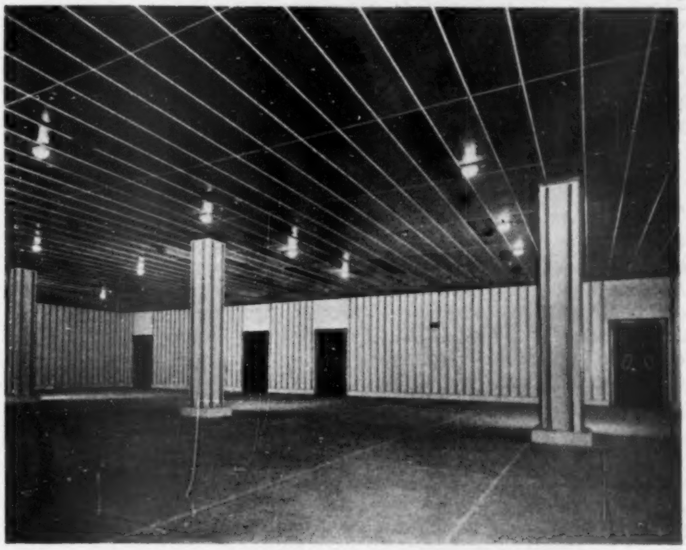
The new cold store will be maintained at a temperature of zero to minus 5° F. and has a capacity of approximately 139,000 c.ft., plus the new insulated cooler compartment with an approximate capacity of 10,000 c.ft.

To facilitate loading by stacker trucks the use of stanchions, except for one centre row, was eliminated by design of a suspended ceiling constructed of Western red cedar framed sections approximately 14 ft. long by 7 ft. wide, infilled with 5-in. Spandoplast expanded polystyrene slabs, all supported by hanger bolts hooked over the concrete beams of the main structure. The top side of the sections was vapour sealed with bitumen felt set in No. 25 Kingsnorth compound and a layer of 3-in. slab cork was fitted to the underside set in bitumen and finished with Aquaseal compound.

The walls and pillars were vapour sealed and insulated with 7-in. slab cork in two layers, finished with Portland cement and painted with Snowcem. Vertical dunnage battens were fixed at 14-in. centres.

The floor was insulated with 8-in. slab cork in two layers finished with $2\frac{3}{4}$-in. granolithic incorporating a $\frac{1}{2}$-in. thickness of Betonac topping. At the perimeter of all walls and pillars a 9-in. high by 6-in. wide concrete curb was formed. The cooler compartment was insulated in a similar manner except for the ceiling which was not suspended but insulated direct to the concrete and faced with metal sheets.

The false ceiling in the cold room forms an air duct. The ceiling was formed to the full area of the cold room 15 in. below the insulated ceiling and constructed of $\frac{3}{4}$-in. resin-bonded plywood sheets varnished two coats on both sides and having



air diffusers set in same at predetermined spacings, the ceiling being supported by the "Grecon" patent metal fixing system having white plastic capping strip. Specially manufactured metal air ducting was fitted connecting the false ceiling to the three air coolers.

Four superfreeze doors 10 ft. high by 5 ft. wide were fitted to the cold room and one 6 ft. high by 3 ft. wide to the cooler compartment, the two doors leading off the loading area having internal rubber crash doors. All doors were fitted with heater gaskets.

An air space was formed under the cold room floor in order to eliminate the necessity for fitting an anti-frost heave heater mat.

The refrigeration plant installed by L. Sterne & Company Limited comprises two 2MAC compound ammonia compressors, one forced-draught economizer condenser and a battery of three finned-type coolers. The coolers were arranged for both hot-gas defrosting and water defrosting.

Those responsible for this installation are :—

Architects : Gornall, Kelly & Partners, Liverpool.

Building contractor : A. Monk & Co., Warrington.

Refrigeration engineers : L. Sterne & Co. Ltd., Liverpool.

Insulation contractors : "J.D." Insulating Co. Ltd., Liverpool.

Sales of domestic refrigerators by Area Electricity Boards during January 1960 totalled 4,341, an increase of 14 per cent. over the previous year. Sales in the 12 months ended January 31 were 165,963, a 113 per cent. increase.

HAY'S WHARF ADDITIONS

(*Continued from p. 372*)

out of the cooler at +10° F. and +5° F. respectively.

The "Freon" Refrigeration Plant

This comprises eight Frigidaire condensing units fitted with 10 h.p motors of the high-starting torque, 3-phase, double-squirrel cage rotor type running at 1,450 r.p.m. Each condensing unit will fulfil its specified duty of 25,000 b.t.u. per hour when evaporating "Freon" at −35° F. This suction temperature is that relating to rooms at −20° F.

The condensers are of the shell and tube type and are fitted with automatic water valves regulating the amount of water passing to the requirements of the condensing set. The starting of any one of the eight sets automatically starts the condensing water pump. Non-self-reset high pressure and self-reset low pressure cutouts are provided as well as oil separators and refrigerant driers.

The condensing sets are controlled in conjunction with the air cooler fans, the automatic starters working in conjunction with the room thermostats.

The Switchboards

There are two switchboards, one for the ammonia plant and one for the "Freon" plant. Both are made by Dewhurst & Partner of Hounslow and located in the engine room. In both cases the switchboard contains the compressor starters, air cooler fan starters, water pump starters, water cooler fan starters and, in the case of the ammonia plant, brine pump and defrost pump and hot water pump starters.

Each cooler fan, pump and compressor has a three position control switch giving automatic-hand-off positions. A separate "Yale" key switch operates each compressor independently if required for running in or other special purpose, over-riding the defrost interlock which normally prevents a compressor from working during defrosting.

Pilot lights on the switchboard show which thermostats are calling for refrigération and which machines are operating as a result. Other pilot lights indicate stoppages due to operation of safety devices, high-pressure cutouts, etc., showing which. Compressor running indicators and fault signals are repeated in the supervising shift engineers' lobby.

Thermometry

A remote reading electric thermometer supplied by Negretti & Zambra as part of the ammonia switchboard has a 10 in. scale and is fitted with three rotary selector switchboxes each containing 32 single pole mercury tube contacts. The temperature scale is translucent and has bold figures illuminated from the back. The equipment is mains operated through a mains unit supplied as part of the equipment.

The thermometer has two ranges: −30° F. to +60° F. and 0° F. to +180° F.

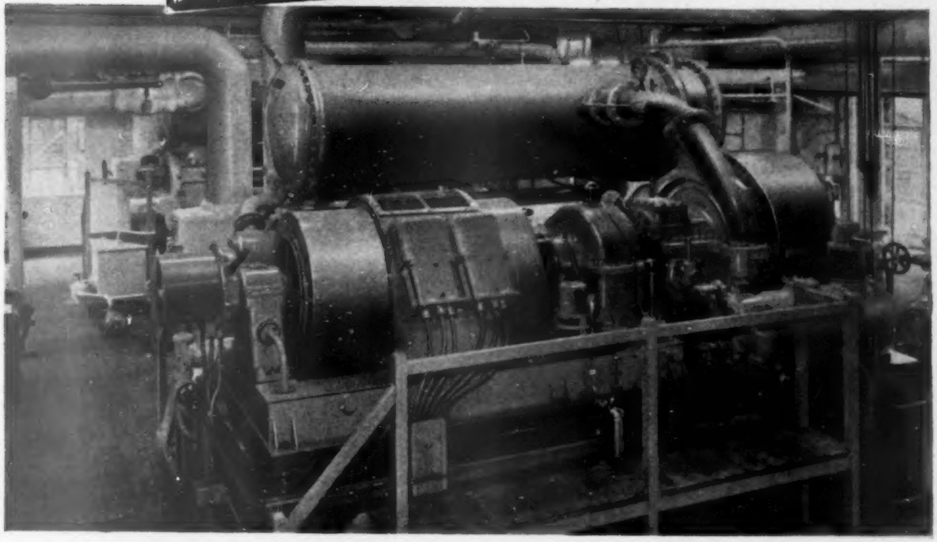
Two thermometers are provided in each chamber; a thermometer is also provided on the evaporators, in the cold and hot brine tanks, on the condensers, on the calorifiers and on the heated drain lines. Provision is also made for taking the external temperature.

The whole of the refrigerating plant, pipework, insulation and electrical installation was carried out by the engineering department of Hay's Wharf Ltd., under the control and supervision of Colonel H. Randal Steward, T.D., B.SC., M.I.MECH.E., A.M.I.C.E., M.INST.R., chief engineer, by whose courtesy we were able to make a detailed examination of this interesting new dual purpose cold store.

A NEW APPROACH TO POWER TRANSMISSION

A NEW approach to power transmission, the "Poly-V" drive, has been developed by the Turner Bros. Asbestos Co. Ltd., Rochdale. This drive makes possible an increase in drive capacity of up to 50 per cent. It has long been the aim of engineers concerned with power transmission problems to combine the flexibility and simplicity of the flat belt drive with the higher speed ratios, shorter centre distances and freedom from slip of the V-belt drive. The "Poly-V" belt is a flat belt with a series of parallel V-shaped ribs moulded on its inner surface. These ribs form the driving surface of the belt and completely fill mating grooves on the pulleys, there being no clearance between the two. Two highly important benefits are thus achieved: firstly, the load-carrying member extends across the full face of the drive, unlike the multiple V-belt drive where part of the total drive width available is wasted by the space between belts; secondly, the grooved i ner face of the belt has about twice the surface area in contact with the pulleys when compared with a multiple belt drive of similar widths. These two principal features mean that the "Poly-V" drive can transmit the same load in less space or a greater load in the same space as a multiple belt drive. A further advantage of the new drive is its versatility and simplicity of installation.

The "Poly-V" drive is made in three different profiles. Two of these—the "L" and "M"—between them cover the whole range of power transmission now covered by five different V-belt cross sections (none of which are interchangeable). This is because the load carrying member of the drive is carried above and outside of the pulley grooves and is thus quite independent of the size and shape of groove. Furthe more, the frequent difficulties met with in matching up V-belts are avoided completely. Considerable savings in belt stocks and in time are therefore possible.



COMPUTER ROOM AIR-CONDITIONING

THE Multi-Vent Division of the Pyle-National Company in the U.S. has recently developed an entirely new combination of ceiling light fixture and air diffuser called the " Multi-Vent Troffer." It has been designed to solve the heat problems created by a large installation of computing machines at the offices of the Travellers' Insurance Company in Connecticut.

Planning to install a Bizmac data processing system in the company's statistical department recently, engineers sought a draught-free air cooling method to offset the heat from more than 20,000 electronic tubes contained in the units, and still retain the modern, clean-lined appearance of the drop ceilings. The " Multi-Vent Troffer," a flush mounted fluorescent lighting fixture that hides a low velocity air diffuser attached immediately above, maintains a vertical, low speed air-flow through tiny slots in the light fixture to provide draught-free cooling, flexibility of room partitioning and to eliminate " cluttered " ceilings.

The several units of the computer system include input machines, by means of which the data enters the process ; the computer, which performs the figure work ; and the output machines which convert the information into usable form. Requiring more than 50 miles of cable, the system consumes power equal to that needed by 1,500 average American homes.

Mr. B. J. Nolan, A. M. ASHRAE, A.INST.R., has resigned his appointment of chief refrigeration engineer, The United Africa Company of Ghana Limited, effective from March 1st, 1960, and he is returning to Dublin to take up an appointment as technical sales director, Auto Services Limited, Harcourt Street and Adelaide Road, Dublin.

PATENTS

APPLICATIONS RECEIVED

February 5—Lec Refrigeration Ltd., and James C., P4222, Gas compressor apparatus. 9—Stone & Co. (Deptford) Ltd., J. Oram, G. C., P4564, Temperature-control apparatus. 11—Kolenko, E. A., and Czerbina, A. G. C4825, Thermo-electric microrefrigerator. 15—Kwik-Kold of America, Inc. Linn, C. A., and Robbins, A. A., C5339, Refrigerating package. 17—Denco Miller Ltd., Miller A. S., P5668, Refrigerating Equipment. 22—Imperial Chemical Industries Ltd. Barlow G.E., and Cochrane, T., P6122, Temperature measuring etc. apparatus. 27—Thermo Extraction Ltd. Parkinson, G., P6949, Refrigeratable display stand. 29—Liquefreeze Co. Inc. Morrison, W. L., C7114, Refrigerating etc. plant etc. ; McFarlan, A. I., C7021, Air-conditioning system ; Stal Refrigeration, A. B., C7023, Products refrigerating method.

COMPLETE SPECIFICATIONS ACCEPTED

February 24—General Motors Corporation, 833,152, Method of making thermal insulation material.

March 2—Reynolds, J. W., 833,682, Refrigerating systems. 16—Electrolux Ltd., 834,901, Absorption refrigerating apparatus.

A leaflet describing the values and applications of refrigerated transport vehicles fitted out by York Shipley Limited, North Circular Road, London, N.W.2, has recently been issued. It outlines the uses to which these vehicles can be put and explains in detail how the company makes its installations to achieve the greatest possible measure of efficiency and convenience. A wide range of temperature requirements is catered for and the company says that its units are light in weight, of robust construction, compact, quiet in operation, and fully protected against vibration.

(*Continued from page 387.*)

Rising, Borg-Warner Corporation, York, Pa. Good engineering of room air-conditioners would be taken for granted, said Mr. Rising, and the premium of leadership could be expected to go to those manufacturers whose engineering and marketing groups could create products with features which the customer wanted, and at a price which he was willing to pay.

Engineering Responsibility and the Challenge, by W. G. Spiegelhalter, General Electric Company, Louisville, Ky. Engineering responsibility was becoming more complex and constituted a challenge as the design of room air-conditioners had to cover such factors as reliability, serviceability, quality and innovation. To meet the challenge, the engineer must be abreast of developments, not only technical, but non-technical as well, so far as they influenced the future course of his product.

The Engineering Responsibility in a Manufacturing Company, by Gerhardt Stoll, Whirlpool Corporation. Engineering responsibility should include new product planning where there were yearly model changes, and should lead marketing in this activity, as control of new products or product changes based on marketing considerations alone may result in products based on the need of meeting competition rather than on customer needs or the state of technology. Engineering and marketing overlapped to some extent but there should be clearly-defined responsibilities for each.

Psychrometric Chart Symposium

Review of Current Psychrometric Chart Situation was the topic of this session, presided over by P. N. Vinther, Zumwalt and Vinther, Dallas, Tex.

High-altitude Psychrometric Charts, by R. W. Haines, Bridgers and Paxton, Albuquerque, N. M. Since the currently published society chart was for sea-level conditions, the author had prepared charts based on the same data but for altitudes of 3,850, 4,900 and 6,900 ft. above sea level, thus making charts available for use in high-altitude localities.

Psychrometric Chart for Altitudes Above Sea Level, by Prof. J. L. Threlkeld, University of Minnesota. A new psychrometric chart was presented which provided for solution of air-conditioning problems for barometric pressures from 10 to 14·696 p.s.i.a. and over the temperature range of 0° to 120° F. The chart was of the Mollier type and was available with a protractor for ready use. The paper also included a review of several older charts.

The Psychrometric Chart Can be Improved, by C. M. Ashley, Carrier Corporation, Syracuse, N.Y. The author proposed the use of a new chart with the conventional co-ordinates, but with modifications which should be easily understood. He also suggested the possibility of a chart plotted with dry-bulb temperature enthalpy resulting in horizontal wet-bulb lines. For taking care of different barometric pressures, a third chart was suggested.

Psychrometric Charts from the User's Viewpoint, by D. D. Wile, Recold Corporation, Los Angeles, Calif.

Mr. Wile suggested that the society should undertake the preparation of a new chart to be of letter size, one colour, on semi-transparent paper, suitable for blue-printing, and made available in pads, with a chart for the low-temperature range and another for the higher temperatures. It was believed that a chart constructed along these lines would be widely used.

Thermodynamic Consistency in the Presentation of Psychrometric Data, by Prof. J. A. Goff, University of Pennsylvania. This paper stated the requirements of thermodynamic consistency that a new society chart must meet to achieve relative permanence and to accomplish sound educational objectives.

Production of Carbon Dioxide and Dry Ice.–2

by K. NURMBERGER and H. KUBLI

(*continued from Modern Refrigeration, March, page 309*)

WHEN cold water at a temperature of between 10° and 16° C. is available, the carbon dioxide can be liquefied under the corresponding pressure at a condenser temperature of 18° to 25° C. If the temperature of the available cooling water is higher, for instance 20° C., a refrigeration plant must be provided for cooling the carbon dioxide condenser. The latter can either be cooled directly by means of the refrigerant or indirectly with chilled water, brine or alcohol-water. In some cases it is advisable to liquefy the carbon dioxide at a low pressure and temperature, for instance, at approximately 14 atm. and —30° C.

At low liquefaction temperature, the power consumption of the CO_2-compressor is, of course, reduced. The refrigeration plant, however, also requires a certain output. The total power consumption, therefore, is the sum of the two and is shown in fig. 5 (Sections I and II) over the liquefaction temperature

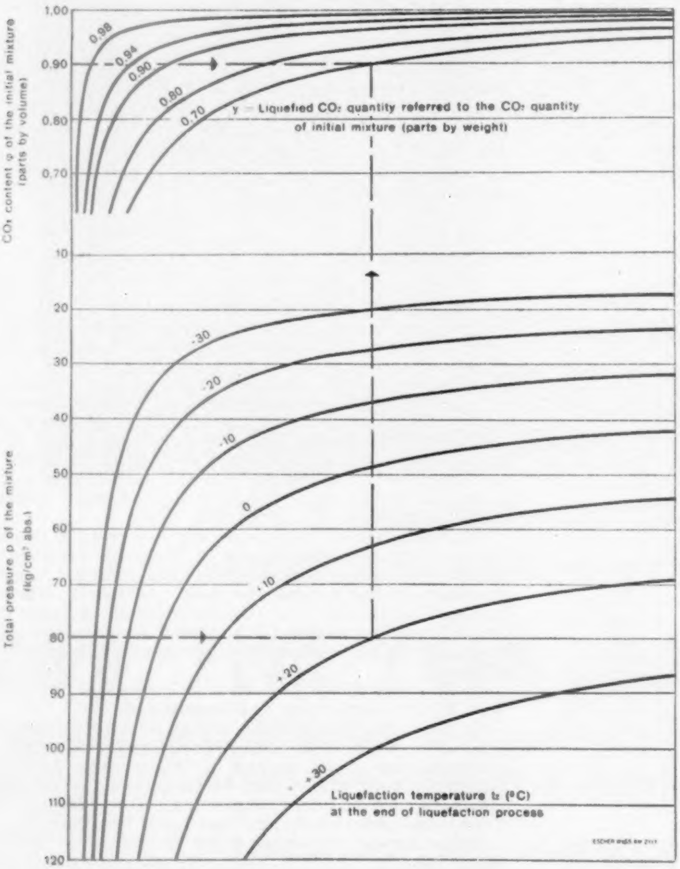


Fig. 6.—Liquid carbon dioxide yield according to the pressure and CO_2 content of the initial mixture and the liquefaction temperature.

Assumptions

The following assumptions were made for the calculations :

CO_2 initial conditions : 1 atm. abs. ; + 20° C. ; pure CO_2-gas.

CO_2-compression : adiabatic compression (n_{ad} = 100 per cent.) ; max. adiabatic discharge temperature after compression, 120° C.

Cooling between the individual compressor stages, assuming a temperature of + 35° C. after the interstage coolers.

Refrigeration plant ; refrigerant NH_3 ; condensing temperature + 30° C. ; temperature difference between the evaporating NH_3 and the condensing CO_2 = 5° C. ; the refrigeration output in kcals. is the product of G_{CO_2} = 1000 kgs. and Δi_v. (Δi_v is the CO_2 enthalpy difference at the liquefaction pressure with + 35° C. superheat before the liquefier and the saturation temperature after the liquefier [in other words without under cooling]); no losses are taken into account for the refrigeration output ; the power consumption is calculated for adiabatic compression.

As a result of these assumptions, the following simple equation is obtained for the theoretical power

Production of Carbon Dioxide and Dry Ice.—2

by K. NURMBERGER and H. KUBLI

(*continued from Modern Refrigeration, March, page 309*)

WHEN cold water at a temperature of between 10° and 16° C. is available, the carbon dioxide can be liquefied under the corresponding pressure at a condenser temperature of 18° to 25° C. If the temperature of the available cooling water is higher, for instance 20° C., a refrigeration plant must be provided for cooling the carbon dioxide condenser. The latter can either be cooled directly by means of the refrigerant or indirectly with chilled water, brine or alcohol-water. In some cases it is advisable to liquefy the carbon dioxide at a low pressure and temperature, for instance, at approximately 14 atm. and —30° C.

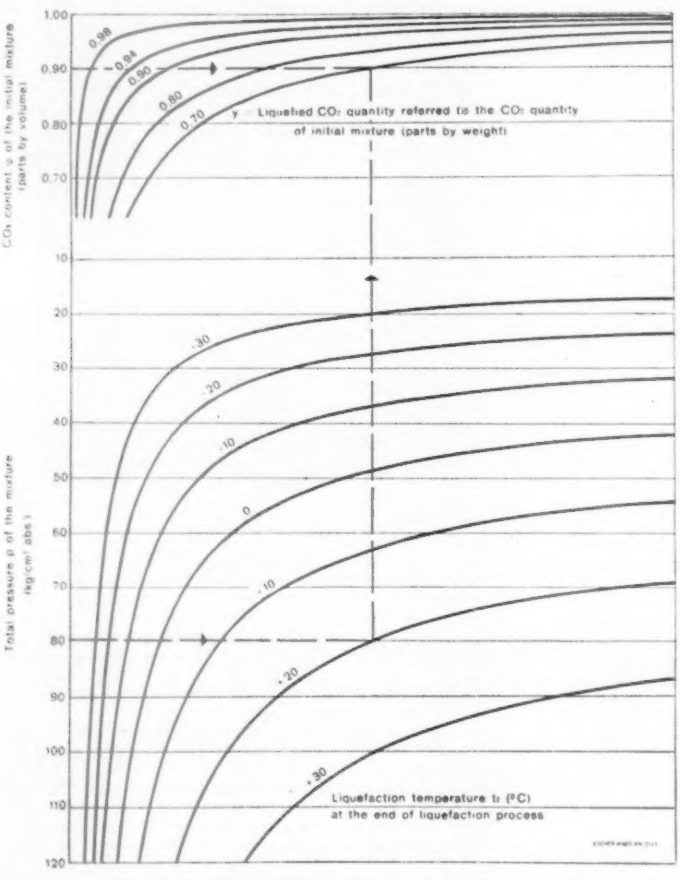


Fig. 6.—Liquid carbon dioxide yield according to the pressure and CO_2 content of the initial mixture and the liquefaction temperature.

At low liquefaction temperature, the power consumption of the CO_2-compressor is, of course, reduced. The refrigeration plant, however, also requires a certain output. The total power consumption, therefore, is the sum of the two and is shown in fig. 5 (Sections I and II) over the liquefaction temperature

Assumptions

The following assumptions were made for the calculations :

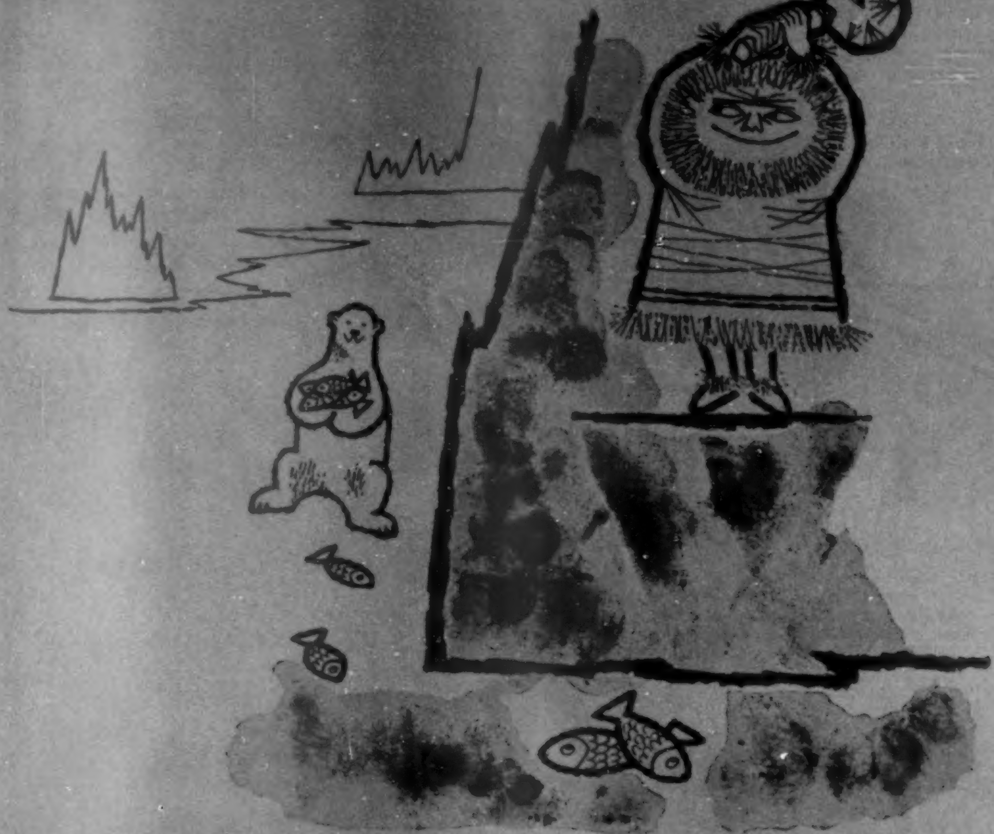
CO_2 initial conditions : 1 atm. abs. ; + 20° C. ; pure CO_2-gas.

CO_2-compression : adiabatic compression (n_{ad} = 100 per cent.) ; max. adiabatic discharge temperature after compression, 120° C.

Cooling between the individual compressor stages, assuming a temperature of + 35° C. after the interstage coolers.

Refrigeration plant ; refrigerant NH_3 ; condensing temperature + 30° C. ; temperature difference between the evaporating NH_3 and the condensing CO_2 = 5° C. ; the refrigeration output in kcals. is the product of G_{CO_2} = 1000 kgs. and Δi_v. (Δi_v is the CO_2 enthalpy difference at the liquefaction pressure with + 35° C. superheat before the liquefier and the saturation temperature after the liquefier [in other words without under cooling]); no losses are taken into account for the refrigeration output ; the power consumption is calculated for adiabatic compression.

As a result of these assumptions, the following simple equation is obtained for the theoretical power



COLD LOGIC

When the problem is the lowering of temperature, it's a matter of cold logic to use 'Arcton' chlorofluorohydrocarbon refrigerants from I.C.I.—the first to introduce this type of refrigerant in Great Britain. (And the people with the greatest experience.)

Not that I.C.I. is resting on its laurels. Behind 'Arcton' refrigerants there's a background of constant research for further improvements. Wherever cooling is the problem, 'Arcton' refrigerants can provide the answer. They're of consistent high quality and low moisture content; and they're non-toxic, non-corrosive and non-inflammable. What's more, there's an 'Arcton' refrigerant to suit *your* need.

'ARCTON' REFRIGERANTS

IMPERIAL CHEMICAL INDUSTRIES LIMITED, LONDON, S.W.1

ICI

There is a tide in the affairs of every business. There comes a moment when you *must* expand if you're to keep pace with your competitors. That's where UDT comes in. UDT helps you replace old equipment, add new, out of income. Which often means it pays for itself out of increased profits. A nice businesslike way to do business. If you think UDT could help you, get in touch with the Manager of your nearest UDT office—the address is in your local directory.

United
Dominions Trust
(Commercial)
Limited

United Dominions House
Eastcheap, London EC3

consumption required for the liquefaction of 1,000 kgs. CO_2 :

$$N_{CO_2} = 1{,}000 \cdot \Sigma\Delta i_{ad} \cdot \frac{1}{860} \text{ kWh}$$

$$N_{Refrigeration} = \frac{1{,}000 \cdot \Delta i_v}{K_{th}} \text{ kWh}$$

K_{th} = theoretical specific refrigeration output in kcal/kWh

$\Sigma \Delta i_{ad} = (i_7 - i_6) + (i_5 - i_4) + (i_3 - i_4)$ in kcal/kg.

$\Delta i_v = i_2 - i_1$ in kcal/kg.

As a result of the assumed maximum discharge temperature of 120° C., a two to four stage compressor, depending on the liquefaction temperature, is necessary.

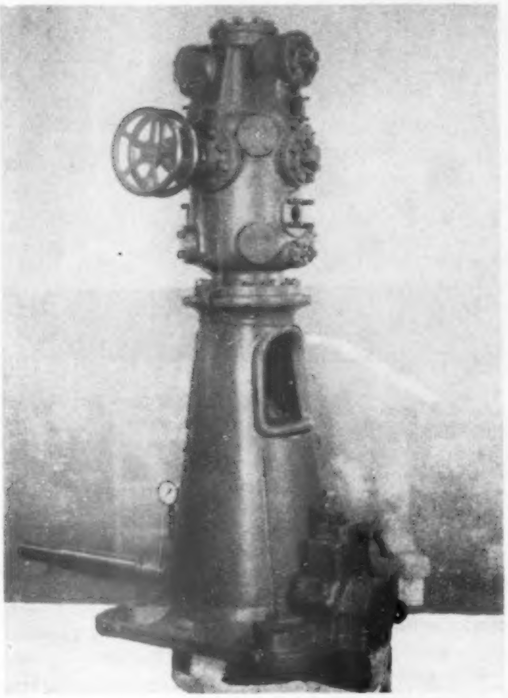


Fig. 7.—Two-stage carbon dioxide compressor for re-liquefying, with steplessly adjustable output control.

The graph in Fig. 6 shows that the total energy consumption reaches a maximum at low liquefaction temperatures for Sections I and II and a reduced energy consumption at higher temperatures.

It should be pointed out that the above calculations show the energy consumption for the liquefaction of 1,000 kgs. of CO_2 at a given liquefaction temperature. If, however, the power consumption for 1,000 kgs. of CO_2 at a certain storage temperature of the liquid CO_2, say —30° C., is required, it is necessary also to consider that the liquid must be throttled from the liquefaction pressure to the storage pressure. Assuming that no vapours may be produced on account of throttling, it is necessary to undercool the liquid CO_2. This under-cooling also requires energy. The higher the liquefaction temperature is, the more energy is required.

When this portion of the total power consumption is also taken into account (Section III in Fig. 5) a fairly flat curve is obtained for the total energy requirements. For

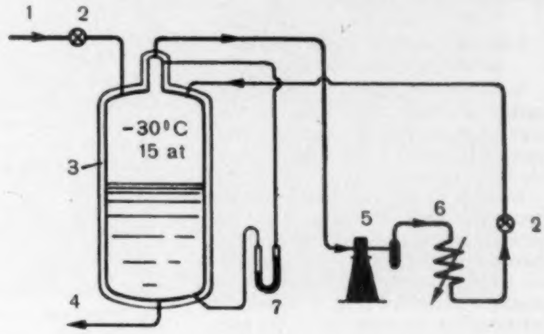


Fig. 8.—Low pressure storage of liquid carbon dioxide. 1. Liquid CO_2 inlet piping. 2. Throttle device. 3. Insulated CO_2 tank. 4. CO_2 discharge. 5. CO_2 compressor. 6. CO_2 condenser. 7. Manometric level indicator.

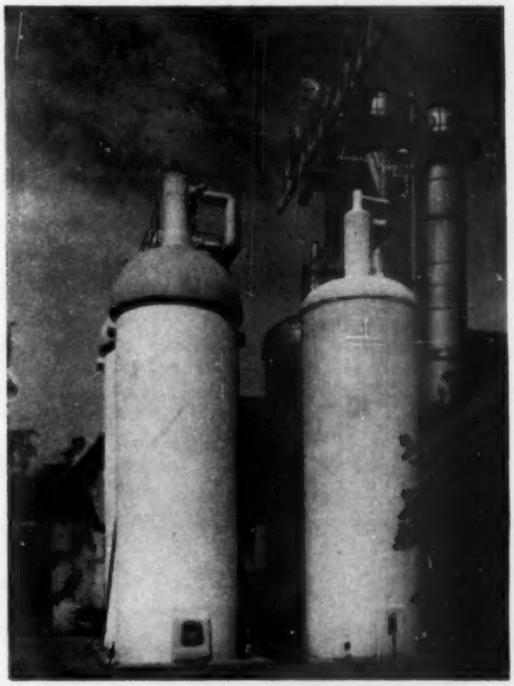


Fig. 9.—Battery of storage tanks of Carba in Zurich for liquid carbon dioxide with a capacity of 4 x 50 tons = 200 tons. Storage conditions approx. 15 atm. and —30° C.

selecting the best liquefaction temperature, therefore, other considerations than the power requirements will have to be taken into account.

A refrigeration plant for CO_2-liquefaction is primarily used in such cases where, on account of unsuitable cooling water conditions, the condensing temperature would otherwise be too near to the critical point.

Liquefaction of Carbon Dioxide Containing Foreign Gases

It is often necessary to liquefy carbon dioxide which contains foreign gases as, for instance, gas from natural springs. These gases have an inert nature.

In such cases, the pressure in the condenser must be higher than the saturation pressure of the carbon dioxide. The greater the proportion of foreign gases the higher is the required pressure. Fig. 6 shows the relationship between the CO_2 content of the gas fed to the condenser, the pressure, the lowest liquefaction temperature (final temperature to which the gas in the condenser or de-aerator is cooled) and the yield, *i.e.* the percentage of the carbon dioxide which is liquefied.

The diagram in Fig. 6 is valid for a mixture of CO_2 with any inert gas and is not limited to air.

The basis for this diagram is essentially as follows: p = total pressure of the mixture; φ_1 = CO_2-content of the mixture at the liquefier inlet, in volume parts; φ_2 = CO_2-content of the mixture at the liquefier outlet, in volume parts; $p_1 = \varphi_1 \cdot p$ = CO_2-partial pressure at the liquefier inlet; $p_2 = \varphi_2 \cdot p$ = CO_2-partial pressure at the liquefier outlet.

$$K = \frac{R_n}{R_{CO_2}} = \text{ratio of the gas constants of inert gas and } CO_2$$

$$\epsilon_1 = K \cdot \frac{p_1}{p - p_1} \text{ kgs. } CO_2/\text{kg. inert gas at the liquefier inlet}$$

$$\epsilon_2 = K \cdot \frac{p_2}{p - p_2} \text{ kgs. } CO_2/\text{kg. inert gas at the liquefier outlet.}$$

The yield of liquid CO_2, referred to the CO_2 quantity of the original mixture (parts by weight) is then

$$y = \frac{\epsilon_1 - \epsilon_2}{\epsilon_1} \text{ or } y = \frac{\varphi_1 - \varphi_2}{\varphi_1 - \varphi_1\varphi_2}$$

The condenser must be constantly de-aerated in order to avoid a growing concentration of inert gases. Together with the inert gases, some CO_2 is lost as the latter can only be condensed out of the mixture as long as its partial pressure is above the pressure corresponding to the liquefaction temperature. Escher Wyss builds condensers which are equipped with a special de-aerating device.

If large proportions of foreign gases are involved, it may be worthwhile fitting an additional de-aerator which operates in series with the condenser. In such cases liquid CO_2 is no longer obtained at one point only but at two. The temperature in the de-aerator must be lower than in the condenser if the total pressure is the same.

For each of the two pieces of equipment, the yield y can be determined with the aid of the diagram in Fig. 6. For this purpose, however, the total pressure in the vessels must be known. This is no longer so easy to determine as when only one vessel is involved. On the one hand, this pressure depends on the CO_2-content of the inlet gas, on the liquefaction temperature and on the yield. On the other hand, it is a result of the adjustment of the throttle device through which the inert gases and some CO_2 are discharged to the atmosphere. Once the individual yields y_1 and y_2 are known, it is possible to determine the total yield $\bar{y}$ according to the formula $y = y_1 + y_2 - y_1 y_2$.

The power consumption for gas compression with carbon dioxide and inert gases is higher than with pure carbon dioxide as the foreign gases and the gas losses have to be compressed in addition to that proportion of carbon dioxide which is liquefied.

To calculate the energy required we use the conventional formula. Average values can be used for the material values.

$$N_{ad} = \frac{1}{102} \cdot \frac{x_m}{x_m - 1} \cdot \frac{V}{3600} \cdot 10\,000 \cdot p_1 \left[\left(\frac{p_2}{p_1} \right)^{\frac{x_m - 1}{x_m}} - 1 \right]$$

where:

N_{ad}: Power requirements for the adiabatic compression in kW

x_m: Average ratio of the specific heats for the CO_2-inert gas mixture

$$x_m = \frac{{}^c p_m}{{}^c p_m - \frac{1.986}{m}}$$

where ${}^c p_m$ is the specific heat of the mixture in kcal/kg.

${}^c p_m = \xi \cdot {}^c p_{CO_2} + (1 - \xi) \cdot {}^c p_{inert}$

m = molecular weight of the mixture

$m = \varphi \cdot m_{CO_2} + (1 - \varphi) \cdot m_{inert}$

ξ = parts by weight of CO_2 in mixture

φ = parts by volume of CO_2 in mixture

V = total suction volume in m^3/h

$V = G_{CO_2} \cdot v_{CO_2} + G_{Air} \cdot v_{Air}$

$$V = \frac{V_{CO_2}}{\varphi_1} = \frac{G_{CO_2} \cdot v_{CO_2}}{\varphi_1}$$

p_1 = pressure before compressor (total pressure) in kgs./cm^2

p_2 = pressure after compressor (total pressure) in kgs./cm^2

At suction conditions of, for instance, 1 atm. abs., 20° C (V_{CO_2} = 0·56 m^3/kg.) the volume V for G_{CO_2} = 1,000 kg./hr. and φ_1 = 0·9 is

$$V = \frac{1{,}000 \cdot 0{\cdot}56}{0{\cdot}9} = 622 \text{ m}^3/\text{hr.}$$

If it is required to determine the power required for 1,000 kgs. of liquid CO_2, the degree of liquefaction y must be taken into account. The power consumption is increased by the factor $\frac{1}{y}$.

The liquid carbon dioxide obtained from gas springs together with inert gases never reaches the high purity obtained with an alkacide plant because, under the conditions in the condenser, inert gases are dissolved in the liquid carbon dioxide and are again released on expansion. However, only very small quantities are involved.

Storage and Bottling of Liquid Carbon Dioxide

The liquid carbon dioxide is either taken to a storage plant or filled into bottles. Small quantities of carbon dioxide can be stored in high-pressure vessels. For larger quantities, the low-pressure system according to Fig. 8 is more convenient. The carbon dioxide is passed into the tank through a throttle valve in which the pressure is reduced to the storage pressure, for instance about 15 atm. corresponding to about —30° C. The CO_2 vapours which are liberated due to throttling and the vapours produced by the influx of heat are drawn off by means of a compressor and returned to the liquefier.

Fig. 9 shows such a storage plant consisting of four storage vessels, each capable of taking 50 tons of

the pressure in the vessel in exactly 15 atm. abs.

A two-stage compressor continuously draws off the CO_2 vapours formed during the preliminary expansion and expansion to the triple point and returns same to the condenser. After the press has been filled with the mixture of CO_2 crystals and liquid CO_2, the carbon dioxide inlet valve is shut off and the pressure in the press compartment is reduced to 3 atm. abs. by means of the two-stage compressor. Then the connection between press and compressor is closed.

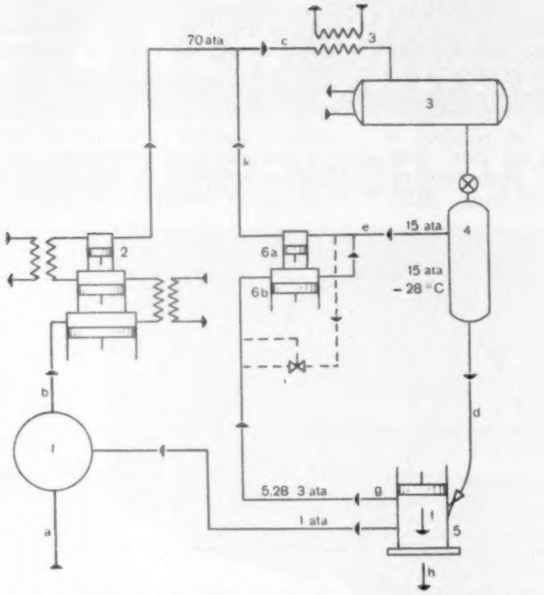
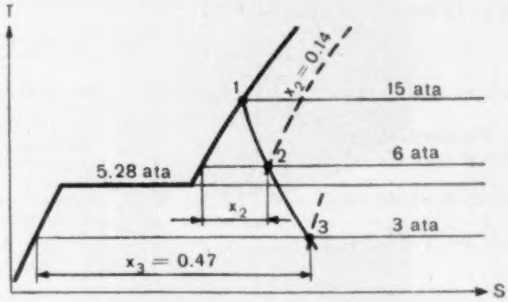


Fig. 10.—Flow sheet of a dry-ice plant. 1. Gas holder. 2. Liquefaction compressor with intermediate cooler. 3. Preliminary gas cooler and condenser. 4. Liquid tank. 5. Ice press. 6. Ice compressor: a—first stage, b—second stage.



liquid carbon dioxide. Instead of a carbon dioxide compressor for returning the gases from the storage tank, a refrigeration plant can be used to cool the liquid carbon dioxide from the condenser to the storage temperature.

The carbon dioxide is filled into the bottles on scales direct from the condenser, provided that the pressure in the condenser is sufficiently high (approx. 65 to 80 atm.). If the carbon dioxide has to be filled into bottles from a low-pressure storage plant, the liquid CO_2 must be pumped to the filling station. As the carbon dioxide from the low-pressure tanks is at a low temperature, the cylinder block is provided with a cooling mantle in order to provide cooling through the evaporation of carbon dioxide or by some other means so as to prevent vapour from forming in the cylinders and valves. Transportation of liquid carbon dioxide can be effected with the aid of insulated tanks on road or railway trucks when large quantities are involved. This method of transportation is far more economical than using bottles on account of the reduced weight of the containers.

Production of Dry Ice

For the production of dry ice, Escher Wyss builds plants according to the Carba process, in which ice is produced at the highest possible pressure — *i.e.* at the triple point pressure 5·28 atm. abs. The process is shown in Fig. 10. The liquid carbon dioxide is passed from the condenser through a throttle valve into a preliminary expansion vessel, expanded to about 15 atm. and thus cooled to about —30° C. From here, the partially expanded liquid carbon dioxide passes through a special throttle nozzle into the dry-ice press and is expanded to the triple point. The press is filled with a mixture of dry-ice crystals and some liquid carbon dioxide, depending on whether the back-pressure in the press is above or below 5·28 atm. abs. From the diagram above, it immediately follows that the precentage of vapour formed can vary considerably.

If the carbon dioxide is expanded to 6 atm. abs. (phase change 1—2) only 14 per cent. by weight of vapour is produced besides the liquid phase. If expansion takes place to 3 atm. abs. (phase change 1—3) approximately 47 per cent. vapour is produced besides the solid phase. In actual fact, injection is performed at 5·28 atm. abs. (triple point). At the end of the injection, vapours are drawn off to about 3 atm. abs. All in all, about 47 per cent. by weight of vapour is produced provided that

The pressure in the press cylinder is now reduced to atmospheric pressure by means of a connexion to the gas holder or to the suction piping of the liquefaction compressor. Simultaneously, the contents of the press are formed hydraulically into a compact, stress-free dry-ice block with a specific weight of about 1·56 kgs./dm³. The quantities of CO_2 which are in circulation during the above process were calculated for a dry-ice-production of 10 tons/24 hours.

The following assumptions were made for the calculations: Pure CO_2 at 1 atm. abs. 25° C. (no inert gases); 10 per cent. losses due to sublimation on extracting the blocks; vapours drawn off down to a pressure of 3 atm. abs. after injection into ice press; intermediate pressure, 15 atm. abs.; condenser pressure, 70 atm. abs.

The individual flow rates for CO_2 were calculated as follows:

$$h^* = \frac{10{,}000}{24} = 416 \text{ kgs./hr.}$$

$$h = \frac{h^*}{0{\cdot}9} = 462 \text{ kgs./hr.}$$

From these values, all other CO_2 quantities in circulation can be calculated by using the same simple method for all three stages (3 atm.

abs. — 1 atm. abs., 15 atm. abs. — 3 atm. abs., condenser pressure — 15 atm. abs.).

Throttling from 3 atm. abs. to 1 atm. abs. x = 4 per cent. so that *(a)*

$$f = \frac{462}{0{\cdot}96} = 482 \text{ kgs./hr.}$$

$$i = f - h = 482 - 462 = 20 \text{ kgs./hr.}$$

Throttling from 15 atm. abs. to 3 atm. abs. x = 47 per cent. so that *(see b)*

$$d = \frac{482}{0{\cdot}53} = 910 \text{ kgs./hr.}$$

$$g = d - f = 910 - 482 = \underline{428 \text{ kgs./hr.}}$$

Throttling from condenser pressure 70 atm. abs. to 15 atm. abs.
x = 52 per cent. so that *(see c)*

$$c = \frac{910}{0{\cdot}48} = 1849 \text{ kgs./hr.}$$

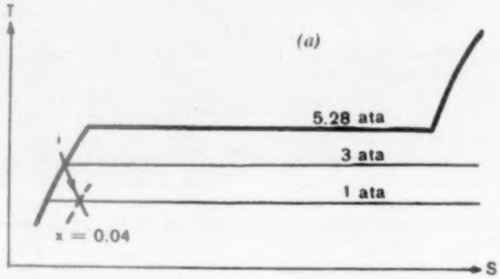
$$e = c - d = 1849 - 910 = \underline{939 \text{ kgs./hr}}$$

Furthermore

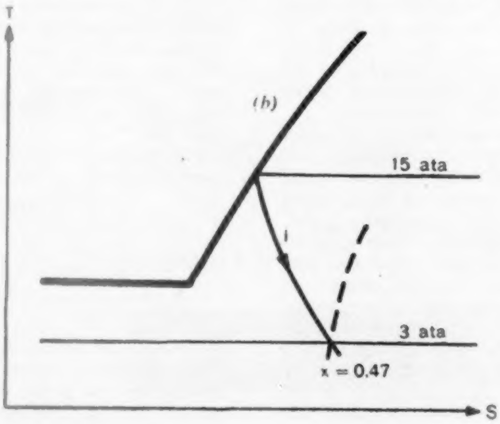
$$k = g + e = 428 + 939 = \underline{1367 \text{ kgs./hr.}}$$

$$b = c - k = 1849 - 1367 = \underline{482 \text{ kgs./hr.}}$$

$$a = b - i = 482 - 20 = \underline{462 \text{ kgs./hr.}}$$

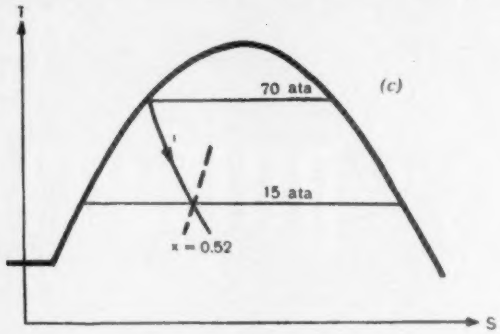


Often used are two two-stage carbon dioxide compressors with adjustable clearance spaces in order to enable them to be adapted to the various operating conditions. Such compressors are used for drawing off the expansion gases during the production of dry ice.



The press is operated hydraulically with the aid of a centrifugal pump operating at 20 atm. Towards the end of compression, a pressure multiplier is used to produce a pressure of 200 to 210 atm. The hydraulic press is controlled by means of a control block which contains all the necessary control valves. By turning a handwheel on the control block from one position to the next, the following operations are performed :

Pump switches on and press is operated at 20 atm ; change over to pressure multiplier, press operated at 200 atm. ; change over to 20 atm., lowering of press table to remove ice block ; press table rises (press closes) and pump is switched off.



The handwheel on the control block is thus again in its original position and the press is ready for the production of a further ice block. The handwheel on the control block can only be turned in one direction in order to avoid faulty manipulation. Opening of the press before atmospheric pressure has been reached is made impossible by means of an automatic check valve so as to avoid accidents. Operation of the press by means of a centrifugal pump and pressure multiplier is much faster than if reciprocating pumps were used.

Presses are built in various sizes :

1. For blocks of—
   - *(a)* about 180 mm diameter and 250 mm length
   - *(b)* about 180 × 180 × 200 mm
   - *(c)* about 250 × 250 × 250 mm
   - *(d)* about 250 × 250 × 320 mm
   - *(e)* about 380 × 380 × 250 mm
   - *(f)* about 500 × 500 × 250 mm
2. For an output of—
   - *(d)* 100 kgs./hr. output
   - *(b)* 100—120 kgs./hr. output
   - (c+d) 250 kgs./hr. output
   - *(e)* 550 kgs./hr. output
   - *(f)* 800—1,000 kgs./hr. output

The same process can also be performed in Carba dry-ice generators without hydraulic presses. These produce compact, stress-free dry-ice blocks with a specific weight of 1·4 to 1·5 kgs./dm³. The diameter of the blocks is 180 mm and they are approximately 1·5 m long. They can be sawn into pieces of any desired length.

Both the presses and the ice generators can be equipped with injection devices with automatic regulation to the triple point and with automatically controlled valves for drawing off the gases.

Special equipment such as, for instance, for washing CO_2 out of a gas mixture with the aid of water under pressure, liquefaction of the carbon dioxide under low or atmospheric pressure with the aid of deep-freezing equipment, re-liquefaction of dry-ice, etc. cannot be dealt with in the scope of this article.

Mention should be made of plants for the recovery of carbon dioxide which was used for storage of beverages such as fruit juices, wine and beer under pressure or which was used in chemical processes and is again released.

Fig. 11 shows an automatic plant in a brewery which draws off, filters and stores in a tank for further use the carbon dioxide which was used in the pressurized storage tanks before the tanks are discharged. In such cases, in which large pressure fluctuations occur, a rotating-piston compressor of the "Rotasco" type is used for compressing the carbon dioxide. This type of compressor is particularly suitable for high and fluctuating pressure ratii.

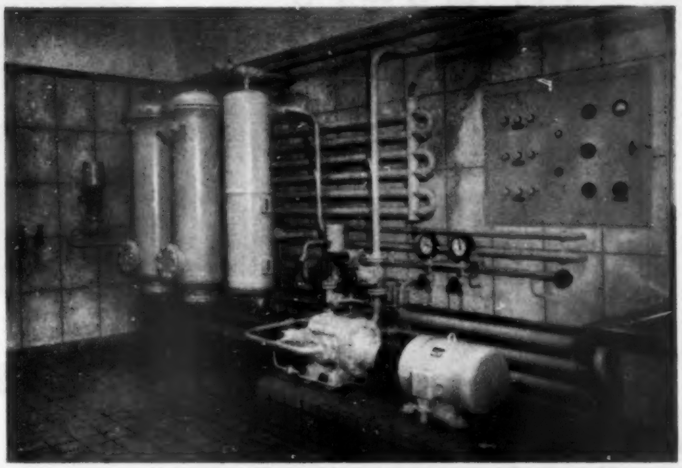


Fig. 11.—Carbon dioxide "Rotasco" type compressor (foreground) and filters in the Hurlimann Brewery in Zurich.

BOOK REVIEW

BULLETIN OF THE INTERNATIONAL INSTITUTE OF REFRIGERATION. No. 6, Vol. 39, 1959. Reviewed by Dr. Ezer Griffiths, Honorary President, I.I.F.

The first item in this issue of the Bulletin consists of a calendar of meetings for 1960. A meeting has been arranged for Commission 1 in June and will be held at the Philips Research Laboratory at Eindhoven. Commissions 3, 4 and 5 will meet in Marseilles in September following a Refrigeration Session organized by the French Association of Refrigeration.

An interesting account of the programme of work of the Federal Institute of Investigations in the Storage of Foodstuffs, Karlsruhe, is included in the Research Institutions Information Section. The Institute is experimenting with the technique of food pasteurization by the use of ionizing radiations, and, although progress is being made states the report, much work remains to be done.

Other reports include those on low-temperature work being carried out at the Laboratory of Research, Grenoble ; investigations into the heat transfer of fluids flowing in rectangular ducts, at the Department of Engineering, Massachusetts Institute of Technology (specific mention is given to the characteristics of flow in heat exchangers of compact form) ; and on experimental work in hand on the Ranque-Hilsch vortex tube at the Technological Institute, Evanston, Illinois.

Some useful literature is abstracted in this issue. Two works on hygrometry concerning, respectively, the hair hygrometer and the psychrometer, are included, and a paper on the theoretical study of the convection of heat from a heated horizontal plate is mentioned. Two abstracts refer to lubrication of refrigerating machines and a Japanese paper on the characteristics of the high-speed multicylinder is of interest. Others in the same section concern the testing of small hermetic "Freon" compressors by the Scientific Research Institute of the U.S.S.R., an unlubricated compressor with a labyrinth piston and its use for the delivery of gases and vapours, pulsating compressors, the heat transfer characteristics of wire and tube heat exchangers, corrosion studies in refrigeration practice, insulation and insulating materials, small gas turbines for mobile air-conditioning, air-conditioning of a modern jet airliner, developments in refrigerated road vehicles and ships (mentioning the liquefaction of chlorine and apparatus for the production of monatomic hydrogen and of ozone), the freezing and cold storage of foodstuffs, advancement during the last 50 years in the cold storage of plant products, controlled atmosphere storage, the cooling of milk and cheese, and the medical aspects of refrigeration. The abstract section also incorporates a useful table giving titles of all the abstracts that appeared in the Bulletin in 1959. These totalled 1,232.

A list of new publications received by the Institute's library is given and the following works are included : "Expansion Machines for Low-temperature Processes," by Collins and Cannaday, Oxford University Press ; "Quick-frozen Foods," by Rogers, Food Trade Press ; "European Refrigeration Research and its Practical Applications," the European Productivity Agency of the Organization for European Economic Co-operation ; "Radiation Preservation of Food," the U.S. Army Quartermaster Corps.

A correction sheet to the brochure entitled "Recommended Conditions for Cold Storage of Perishable Foodstuffs" is inserted in the Bulletin.

COOLING COIL PERFORMANCE*

By L. C. BULL, A.M.I.Mech.E., M.I.H.V.E.

SYNOPSIS

In an earlier paper, attention was focused on the performance of coils in use for simultaneously cooling and dehumidifying air, and the approach was mathematical. In this paper a wider field has been covered and qualitative reasoning has been used wherever possible. In this way the author hopes that he has been able to arrive at sufficient information on the general performance of finned pipe cooling coils to meet the needs of practising air-conditioning and automatic control engineers. Manufacturers of cooling coils in this country do not publish tables of ratings from which an air-conditioning engineer can consider which coil will best suit his requirements.

THE cooling surface on the air side of a coil can be from 12 to 24 sq. ft. per row for each sq. ft. of face area. The equivalent figure on the coolant side is usually between 1·0 and 1·5. When the fins are made of copper the fin efficiency varies from 85 to 95 per cent. Practical considerations often control the amount of extended surface which can be provided on the air side of a coil.

Fins are frequently spaced at ⅛-in. intervals and may be even closer. Cleaning is therefore difficult and it is important that only filtered air be allowed to pass through the coil. Generally a wide short coil is cheaper than a narrow high one, but the dimensions for a given face area may be controlled by the space available and requirements on the coolant side. When water or brine are used as coolant, the velocity in the tubes is usually from 3 to 6 ft./sec.

When the coolant is an evaporating refrigerant it leaves the coil as a superheated gas and, depending upon the characteristics of the expansion valve, may have as much as 12° F. superheat. Under these conditions there is a considerable difference between the effectiveness of the coil surface at the refrigerant leaving end and elsewhere.

Other things being equal, a lower coolant temperature is required for a direct expansion coil than would be needed with chilled water or brine passing through the tubes at about 4 ft./sec.

With most coil designs the practical minimum temperature difference between *entering* coolant and leaving air is from 6° to 8° F. This compares quite well with the performance of a conventional air washer. Here the temperature of the leaving air approaches that of the *leaving* water and this tends to compensate for the extra thermal resistance between coolant and air in the case of a coil.

If there were perfect contact between the air and external coil surface the air would in a typical instance be cooled from 75° to 60·25° F., that is, through a range of 14·75° F. The actual range is 75° to 63° F., or 12° F. Thus the coil efficiency or contact factor β is $12/14{\cdot}75 = 0{\cdot}814$.

Typical contact factors for a finned coil are given in the following table.

Face velocity ft./min.	Number of rows						
	1	2	3	4	5	6	8
300	0·372	0·605	0·752	0·844	0·902	0·939	0·976
400	0·356	0·584	0·732	0·827	0·888	0·928	0·970
500	0·343	0·579	0·716	0·814	0·878	0·920	0·965
600	0·332	0·554	0·702	0·801	0·867	0·912	0·960

Coil and Condensing Unit Balance

The performance of a direct expansion coil depends not only upon the characteristics of the coil but also upon those of the condensing unit with which it works. Figs. 1 and 2 have been prepared to illustrate coil and condensing unit balance.

* Excerpts from a paper presented to the Institution of Heating and Ventilating Engineers in London last month.

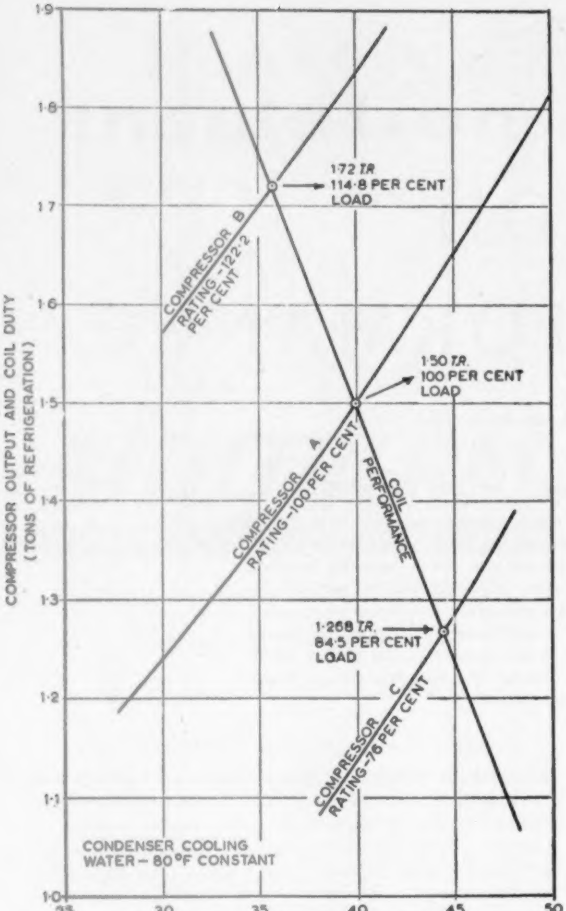


Fig. 1.—Coil and condensing unit balance: coil performance at various evaporating temperatures.

Suppose we know that a certain coil in reducing air from 84° F. and 80·2 gr./lb. to 59·75° F. and 64·7 gr./lb. has a load of 1·5 *T.R.* and that the refrigerant evaporating temperature under these conditions is 40° F. The coil performance at other evaporating temperatures can be estimated graphically as shown in Fig. 1. The construction is carried out as follows :—

(1) Mark the inlet and outlet air state points on the diagram, join them with a straight line and produce this to cut the saturation curve.

(2) Draw a line which passes through the outlet air state point and is parallel with the saturation curve where this meets line (1).

(3) Draw lines of constant heat content through inlet and outlet air state points.

(4) Line (1) strikes the saturation curve at 52·5° F. Choose a higher temperature, say 55° F., and draw a straight line from the inlet air state point to the point on the saturation curve representing 55° F.

(5) Draw a line of constant heat content through the intersection of line (4) with line (2). By measurement note that the heat removal under this new condition is 1·268 *T.R.* Calculate the evaporating temperature as follows :—

$$55 - (52{\cdot}5 - 40)\frac{1{\cdot}268}{1{\cdot}5} = 44{\cdot}23^\circ \text{ F.}$$

(6) Repeat operation (4) with a lower point on the saturation curve, say 50° F.

(7) Draw a line of constant heat content through the intersection of lines (6) and (2). By measurement

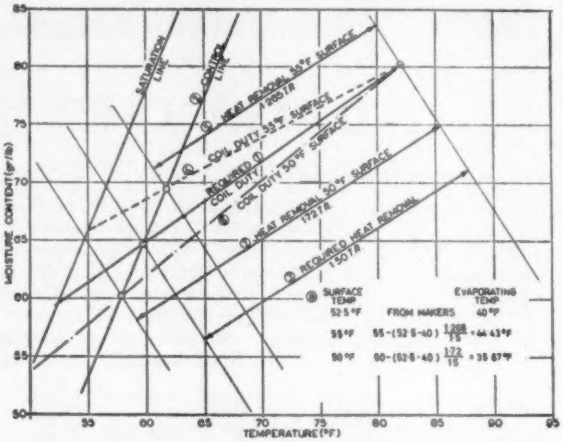


Fig. 2.—Coil and condensing unit balance: curve of coil load versus evaporating temperature, in conjunction with performance curves of three condensing units.

note that the new load is 1·72 *T.R.* Calculate the evaporating temperature as follows :—

$$50 - (52{\cdot}5 - 40)\frac{1{\cdot}72}{1{\cdot}5} = 35{\cdot}67^\circ \text{ F.}$$

Referring to fig. 2, the information from fig. 1 can be used to plot a curve of coil load versus evaporating temperature. Also on fig. 2 have been plotted the performances of three condensing units, each supplied with condenser cooling water at a constant temperature of 80° F.

Examination of fig. 2 shows that compressor A exactly meets our requirements. Compressor B has 22·2 per cent. more capacity at 40° F. evaporating temperature than Unit A. If it were connected to our coil, however, the balance point would be at 35·67° F. evaporating temperature, and the output only 14·8 per cent. more than that of Unit A. The air side performance would be that indicated by line (6) of fig. 1.

Unit C is smaller than necessary, its output at 40° F. evaporating temperature being 76 per cent. of that obtained under similar circumstances with Compressor A. When it is connected to our coil, however, the balance point is 44·43° F. and output 84·5 per cent. of that secured with Unit A. The motor might therefore be overloaded. Air side performance would be that indicated by line (4) of fig. 1.

BUYERS' GUIDE

REFRIGERATED PRODUCE

FROZEN FISH

George Tabor, Ltd., Imperial House, Pudding Lane, London, E.C.3. 'Phone: Mansion House 8044. Wires: "Passport, London." A strong and well-established organization for marketing FROZEN FISH throughout the U.K. and Europe. Proprietors of "NEWBAY" and "TASAM" Salmon and other Frozen Fish. Producers of Oysters and Smoked Fish, Marinated Herrings and Sprats.

MEAT

Thomas Borthwick & Sons Ltd., Audrey House, Ely Place, and Central Markets, London, and the Provinces. Telegrams: "Overdraw, London." Tel.: Holborn 5234 (7 lines).

HIGH VELOCITY AIR CONDITIONING

THE ADVANTAGES OF TWIN-DUCT SYSTEMS

DUCT velocities for all conventional ventilating and air-conditioning installations have, in the past, been kept in the region of 1,000 to 1,500 ft./min., said Mr. J. K. W. MacVicar, A.I.MAR.E., when he delivered a paper on " High-Velocity Air-Conditioning " at the Institution of Heating and Ventilating Engineers recently. American influence had been strong in this field. Marine practice in the United Kingdom was, however, to operate at twice this figure or more, and velocities in main ducts were rarely less than 2,000 ft./min., while in machinery spaces 3,000 ft./min. were not uncommon. A basis had already been set up for the development of what was now known as high-velocity systems.

Many methods were available for conditioning modern multi-room, multi-storey buildings; a variety of design objectives and various architectural and structural features of the building made it obvious that no " best for all " systems could be selected and applied indiscriminately. For each application there was usually more than one type of system which would fill the functional requirement specified by the owner for the occupants. Relative merits of the different systems must be evaluated on the basis of initial and operating cost as future adequacy and flexibility.

However, this paper was mainly concerned with the application of twin-duct high-velocity systems, but reference was also made to alternative methods of achieving individual control in multi-storey office buildings.

" In the dual-duct system," said Mr. MacVicar, " mixing boxes are connected directly to the hot and cold supply ducts, and temperature control is an integral function of the box itself. Each space is served by one or more mixing boxes, which reduce high duct velocities to lower outlet velocities, provide attenuation of noise, and mix air in correct proportions to maintain desired space conditions.

" The advantage of using two supply ducts instead of one is the ability to satisfy different rooms or areas which may simultaneously require different amounts of heating or cooling."

Generally speaking, for land installations high-velocity systems included most systems where the initial duct velocities rose above 2,000 ft./min. and the duct air pressures were above 2 in., static pressure rising to a maximum of 6,000 ft./min. and 6 in. static pressure.

Experience on past systems pointed to duct velocities in the region of 4,000 to 4,500 ft./min. as being the most economical with regard to fan horse-powers and the ability of the mixing boxes to pinch out pressures with minimum noise generation.

" Design air quantities for cold ducts are generally 100 per cent. of required air volume. However, hot ducts need not be sized for more than a percentage of the maximum figure, sometimes as low as 50 per cent. and as high as 75 per cent. of the cold duct air quantity.

" The main advantages of twin-duct air-conditioning systems are as follow: (a) The system can cool and heat simultaneously without the need for central zoning or change-over during the seasons. It is very often advantageous to provide more than one central plant in order to provide greater flexibility of shut-off, and in many cases this is forced on the designer due to cumbersome central apparatus which might be required when large air quantities are being handled. (b) All conditioning equipment is centrally located, simplifying maintenance and operation. (c) The system can utilise maximum outdoor air for cooling purposes during the intermediate season. (d) There is no need to have water or steam piping, electrical equipment or wiring in the treated space.

" There are many twin-duct cycles which can be applied in large multi-storey multi-zone installations. These cycles actually do not represent any new ideas in air-conditioning procedure. Thermodynamically, all dual-duct cycles are equivalent to conventional single-duct systems with face and by-pass dampers at the cooling coil. The twin-duct system possesses extreme flexibility to zone automatically each area or room independently.

" With the advent of high-velocity air-conditioning and its high potential noise level when compared with conventional low-velocity installations, the intelligent application of sound-absorbing material has become a necessity if the maximum overall efficiency of a high-velocity system is to be obtained.

Main Sources of Noise

" The main sources of noise in a system are the fan equipment, pressure reduction at the attenuator boxes, and outlet grilles. Noise due to refrigeration equipment, pumps, motors, etc., is excluded from this discussion of the air distribution system. However, this source of sound generation must be controlled adequately, as it can be transmitted to the occupied zones via the air ducts and by mechanical transmission.

" The selection and design of equipment are the major factors in the minimization of noise generation and pressure reduction.

" The first of the alternative methods of achieving temperature control on a small area basis to be discussed is the air-water induction system utilizing medium to

high velocities in the primary air ducts. This system could be considered more of a high-pressure system than a high-velocity system, since the induction units require from 0.8 in. to over 2 in. static pressure in order to convert this to kinetic energy by ejecting the primary air through a nozzle thereby inducing a flow of secondary air over a cooling/heating coil. The ratio of secondary air to primary air is usually arranged at a value of 3 : 1. In the central station apparatus, primary air is first cooled to a low dew-point condition and then delivered in fixed proportions through medium/high-velocity ductwork to terminal induction units in each of the treated areas. Most frequently the primary air is all fresh air with no recirculation.

" The primary air plant is designed to handle all the latent cooling load, leaving only sensible heat to be absorbed by the secondary cooling coil on the induction unit or units in each space.

" Because the air/water induction system derives its cooling effect from both air and water, the volume of air circulated is lower than that of other systems, this primary air quantity is generally about 30 per cent. of what would be required in an all-air system of comparable capacity.

" More recent development of the air/water system is the three-pipe system. This system gets its name from the fact that each induction unit is served by separate chilled water and hot-water pipes and by a common line which acts as a return main pipe for whichever of the two temperature liquids is passing through the units. In the main plant room individual pumps circulate the chilled water and the hot water.

Complete Control

" From a temperature control aspect and close control of humidity, reheat systems are extremely good, as the system has available cold air for cooling and steam or hot water for heating at any time of the year, thus making it possible to keep complete control of space conditions irrespective of load changes.

" A recent installation in this country applied to a seven-storey office building will help to illustrate the type of system which can be incorporated in a modern structure. The building is situated in central London, and it has locked double windows in order to eliminate street noise and dirt. Some form of air-conditioning was therefore essential, and a high-velocity twin-duct system was selected because this gives individual room control, occupies a minimum of space and gives a high degree of flexibility.

" The system is capable of maintaining a dry-bulb temperature of 70° F. and 50 per cent. relative humidity. The noise level in the occupied space due to the air-conditioning plant has been designed not to exceed 40 decibels.

" The central plant is located in the basement and consists of a 65-ton chilled water refrigeration plant, centrifugal extract fan, viscous pre-filter, electrostatic main filter, aerofoil bladed backward curved high efficiency D.I.D.W. supply fan, and on the fan discharge, heater battery and air washer. The plant is completely automatic in operation and a time switch is incorporated to switch on in the morning and off at night.

" From the central plant room the twin supply mains conveying hot and cold air feed vertical ducts situated in front of the mullions between each pair of units. These ducts are arranged to feed constant volume mixing boxes, approximately 230 in number, situated under the windows. The boxes in each individual room are controlled by separate space thermostat. Provision has been made to enable the thermostat position and the number of mixing boxes served by each thermostat to be very quickly and easily altered to permit the layout of the internal partitions to be changed.

" One floor of the building has no internal partitions and this is served principally by single-duct units, obtaining their conditioned air from a common mixing box giving zone control only. Internal areas are supplied by ceiling-type double-duct mixing boxes mounted above false ceilings and distributing air to the conditioned spaces through grilles or diffusers.

" The thermostatic controls of the central plant are of the pneumatic type, as are those for the mixing box volume and temperature control, and are arranged to compensate the hot duct temperature as the outside temperature falls, while a dew-point controller after the washer is reset by a humidistat mounted in the return air duct to maintain average space relative humidity. The dew-point controller is arranged to operate in sequence fresh and return air dampers when outside conditions are favourable, followed by a three-way mixing valve on the air washer spray circuit to mix the required proportion of chilled and return water to maintain the desired dew-point.

" In order to conserve on refrigeration a separate wet bulb controller in the fresh air inlet is arranged to open the fresh air damper to give the maximum outside air quantities when conditions are favourable.

" It is interesting to note that the occupants of one private office in this building find a temperature of 64° F. most comfortable, whilst another individual prefers 72° F., and the system satisfactorily maintains both extremes of temperature."

THE FRUIT ANNUAL AND DIRECTORY. 600 pp. British-Continental Trade Press Ltd., 222, Strand, London, W.C.2. £1 post free.

The 1960 edition of this valuable work conforms to its usual high standards of orderliness and quality. Designed to be of use to everyone concerned with the production, processing or distribution of fresh, frozen, canned or dried fruit, and edible nuts, it gives a concise survey of crops, exports, imports, and consumption, etc., in producing and consuming countries, and data on the latest developments in quick freezing and packing of fruit and vegetables.

A fruit supplies calendar, dictionary of trade terms, lists of trade associations and specialized journals, and a fruit shippers guide, form a useful reference section. The latter lists shipping firms and their individual fruit cargo vessels with full particulars. The World directory section lists over 5,000 packers, exporters, importers, wholesalers, canners, quick-freezers, and other processors and merchants dealing with fruits and nuts in 56 countries, also suppliers of machinery, materials and equipment for packing and processing, cold storage and transport firms and a classified buyers guide.

COLD STORAGE SECTION

INDEX TO ADVERTISERS

PAGE

Abage (Fulham) Ltd. ... March
AC-Delco ... ... November
Aero Pipe & Glass Co. Ltd. March
Air Control Installations Ltd.... 419
Alpine Insulations Ltd. 428
Armstrong Patents Co. Ltd. March
Associated Electrical Industries Ltd. ... ... November
Aubanel & Alabaster Ltd. ... 426

Baxenden Chemical Co. Ltd. ... 350
Bennett (R. A.) & Co. ... March
Bonallack & Sons Ltd. ... January
Borthwick (Thos.) & Sons Ltd. 420 & 423
British Bitumen Emulsions Ltd. 416
British Railways 356
Bucknall (Henry) & Sons Ltd. February
BX Plastics Ltd. 355

Cape Asbestos Co. Ltd.... December
Cassey (Walter) Ltd. 425
Cellgrave & Co. Ltd. 356
Chambers Wharf & Cold Stores Ltd. 424
City Electrical Co. ... January
Classified Advertisements 361, 362 & 363
Cole (E.K.) Ltd. ... January
Commerce Factors (G. B.) Ltd. March
Commercial Plastics (Sales) Ltd. March
Consolidated Zinc Corporation Ltd. ... ... March
Cork Growers Trading Co. (1931) Ltd. 431
Cork Insulation & Asbestos Co. Ltd. 429
Craven (Richard) & Co. Ltd. March
Crompton Parkinson Ltd. ... 339

Danfoss Manufacturing Co. Back cover
Daniels (T. H. & J.) Ltd. ... 351
Dean & Wood (London) Ltd. ... 334
Dex Industries Ltd. ... March
Distillers (The) Co. Ltd. March
Distrene Ltd. ... ... February
Douglas (Wm.) & Sons Ltd. Cover ii
Dunham-Bush Ltd. 341
Dutton (Leonard) & Sons ... 420

Eastwood Mill Co. Ltd. December
Elliott Bros. (London) Ltd. February
Ellis & Co. (Refrigerators) Ltd. November
Evomastics Ltd. ... March
Expanded Rubber Co. Ltd. Cover iii

Foamair Ltd. ... ... February
Frigidaire ... ... March
Frozt-ed-Aer Refrigerators ... 359
Fylde Ice & Cold Storage Co. Ltd. 426

Gill (H.) Stampings Ltd.... ... 427
Girdlestone Pumps Ltd. ... 422
G.M. Power Plant Co. Ltd. ... 431
Great Grimsby Coal, Salt & Tanning Co. Ltd. ... March

Hall (J. & E.) Ltd. 401
Hawker Siddeley (Hamble) Ltd. 338
Hay's Wharf Ltd. 424

PAGE

Heath, Hicks & Perken (Thermometers) Ltd. 352
Heyde (J. Bennett) & Co. Ltd. March
H.R.P. Ltd. ... ... March
Hunt Heat Exchangers Ltd. ... 420
Hussmann British Refrigeration Ltd. ... ... March

Ice Machinery Mart 419
Icemaster Ltd. 342
Imperial Aluminium Co. Ltd. March
Imperial Chemical Industries Ltd. (" Arcton ") 405
Imperial Chemical Industries Ltd. (Isocyanates) ... ... February
Imperial Chemical Industries Ltd. (Metals) ... ... February
Imperial Chemical Industries Ltd. (Plastics Division) ... March
Industrial and Mining Supplies Co. Ltd. 363
Industrial Components Ltd. ... 430
Injection Moulders Ltd. ... 348
Insulated Bodies Ltd. 350
International Cold Storage & Ice Co. Ltd. ... ... January

Jackstone Froster Ltd. ... 413 & 419
" J.D." Insulating Co. Ltd. 342 & 398
J.C.P. Industrial Clothing Ltd.... 429
J. R. Enterprises Ltd. ... February
Junta Nacional Da Cortica ... 427

K.D.G. Instruments Ltd. December
Keenan (Matthew) & Co. Ltd. 416
Kelvinator Ltd. ... ... March

Lancastrian Evaporators Ltd. ... 344
Lec Refrigeration Ltd. 331
Lightfoot Refrigeration Co. Ltd. 409
Lister (R. A.) & Co. Ltd. ... 357
Loheat Ltd. 431
London Fan & Motor Co. Ltd. 364

Magnetic Valve Co. Ltd. November
Mann Egerton & Co. Ltd. January
McNeill (F.) & Co. Ltd.... November
Mercantile Credit Co. Ltd. ... 414
Miller (Arthur) Ltd. 425
Minikay Ltd. 330
Modern Refrigeration ... 419
Monsanto Chemicals Ltd. March

Nathan's Equipment Ltd. ... 350
Negretti & Zambra Ltd ... 332
Newalls Insulation Co. Ltd. March
Newnes (George) Ltd. March
Notley Ltd. 419

Patrick (W.) & Son Ltd. ... 420
Perfection Parts Ltd. ... November
Pertwee & Back Ltd. ... 419
Pilot Refrigerated Installations January
Porter (Alfred) & Co. Ltd. March
Pressed Steel Co. Ltd. ... March

Ranco Ltd. ... ... March
Rapid-Ice-Freezing Ltd. March
" Refrigerating Engineering " ... 426

PAGE

Refrigeration Appliances Ltd. ... 333
Refrigeration Spares Ltd. March
" Refrigeration Journal " The 426
Refrigerator Components Ltd. ... 352
Regwell Ltd. ... ... November
Richards Cork & Insulation Products Ltd. ... March
Robinson Bros. Cork Growers Ltd. 430

Scott (David) & Co. Ltd. ... 356
Searle Manufacturing Co. Ltd.... 354
Secura Refrigerated Cabinet Co. 340
Sharp & Law Ltd. ... February
Shell Chemical Co. Ltd. 329 & 353
Siebe, Gorman & Co. Ltd. March
Silica Gel Ltd. 420
Smith's Insulation Ltd. ... Front cover
Smithfield Refrigerator Co. ... 345
S. & R. Electronic Products Ltd. 352
S.N. Engineering Co. Ltd. ... 363
Spiral Tube & Components Co. Ltd. 348
Spiro Gills Ltd. ... ... March
Stempel-Hermetik Gmbh. March
Sterne (L.) & Co. Ltd. ... 336 & 337
Styrene Products Ltd. ... December

Tabor (George) Ltd. 420
Taylor (W. A.) Ltd. 358
Teddington Refrigeration Controls Ltd. 349
Temperature Ltd. ... 343 & 419
Tucker (Geo.) Eyelet Co. Ltd. ... 427

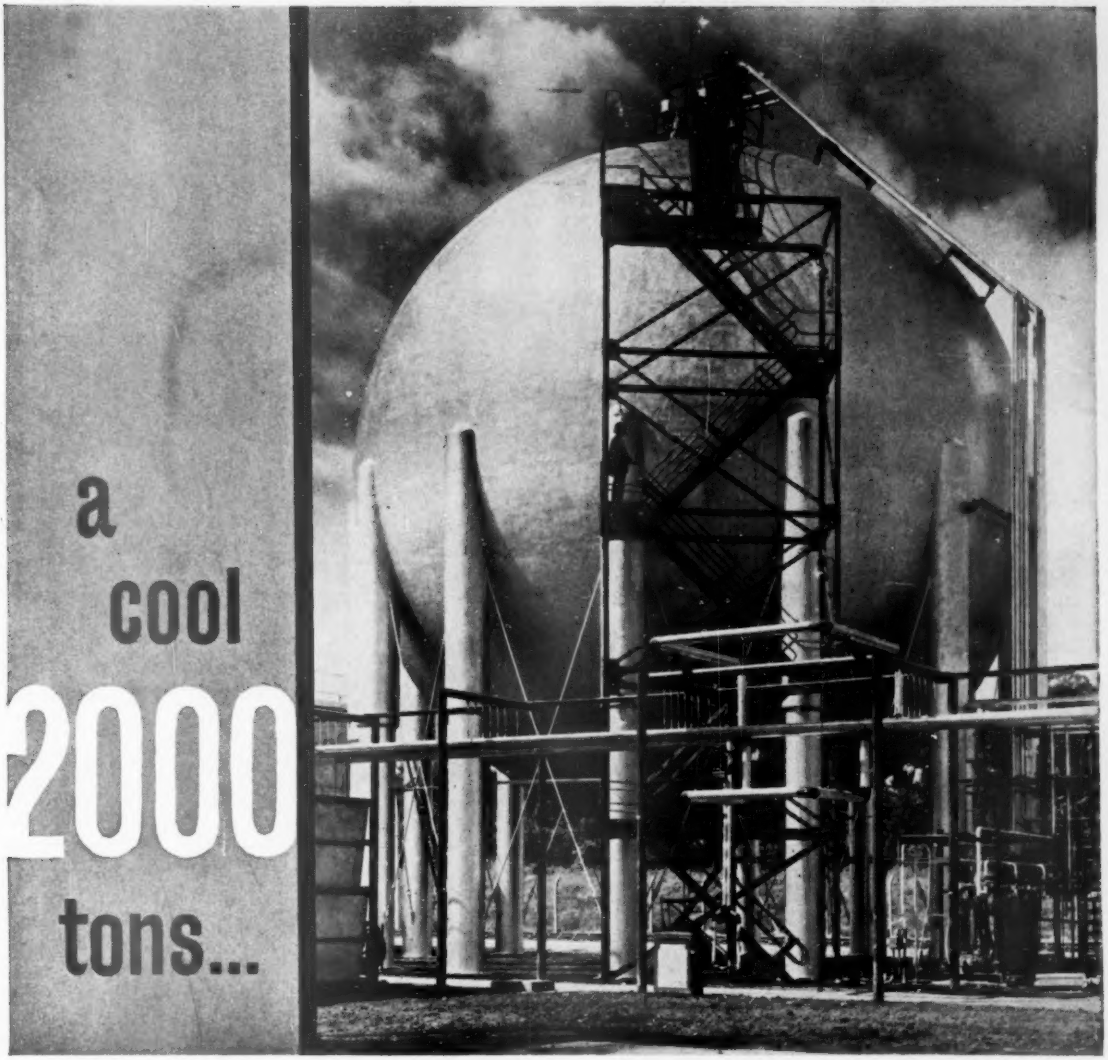
U.D. Engineering Co. Ltd. ... 346
Union Carbide Ltd. 347
Union Cold Storage Co. Ltd. ... 423
L'Unite Hermetique 360
United Air Coil Ltd. ... January
United Carlo Gatti, Stevenson & Slaters Ltd. ... ... February
United Dominions Trust (Commercial) Ltd. 406

Visco Engineering Co. Ltd. ... 359

Wallington Jones & Co. Ltd. ... 428
Wensley (Chas.) & Sons Ltd. January
West (Ernest) & Beynon Ltd. February
West (W. Van) & Zonen ... 420
Western Detail Manufacturers Ltd. ... ... March
Western Ice & Cold Storage Co. Ltd., The ... ... March
Westool Ltd. ... ... November
Whitaker (C. L.) & Co. Ltd. ... 428
White (J. Samuel) & Co. Ltd. March
Wigglesworth (Frank) & Co. Ltd. 420
Williams (G.) Engineering Co. Ltd. 410
Winget Ltd. ... ... March
Winn & Son Ltd. ... ...March
" Wola " 364
Wood, L. D. (Eldwood) Ltd. ... 402
Worthington-Simpson Ltd. November

York Shipley Ltd. ... March
Yorkshire Imperial Metals Ltd. 335

Zero Electric Ltd. 431



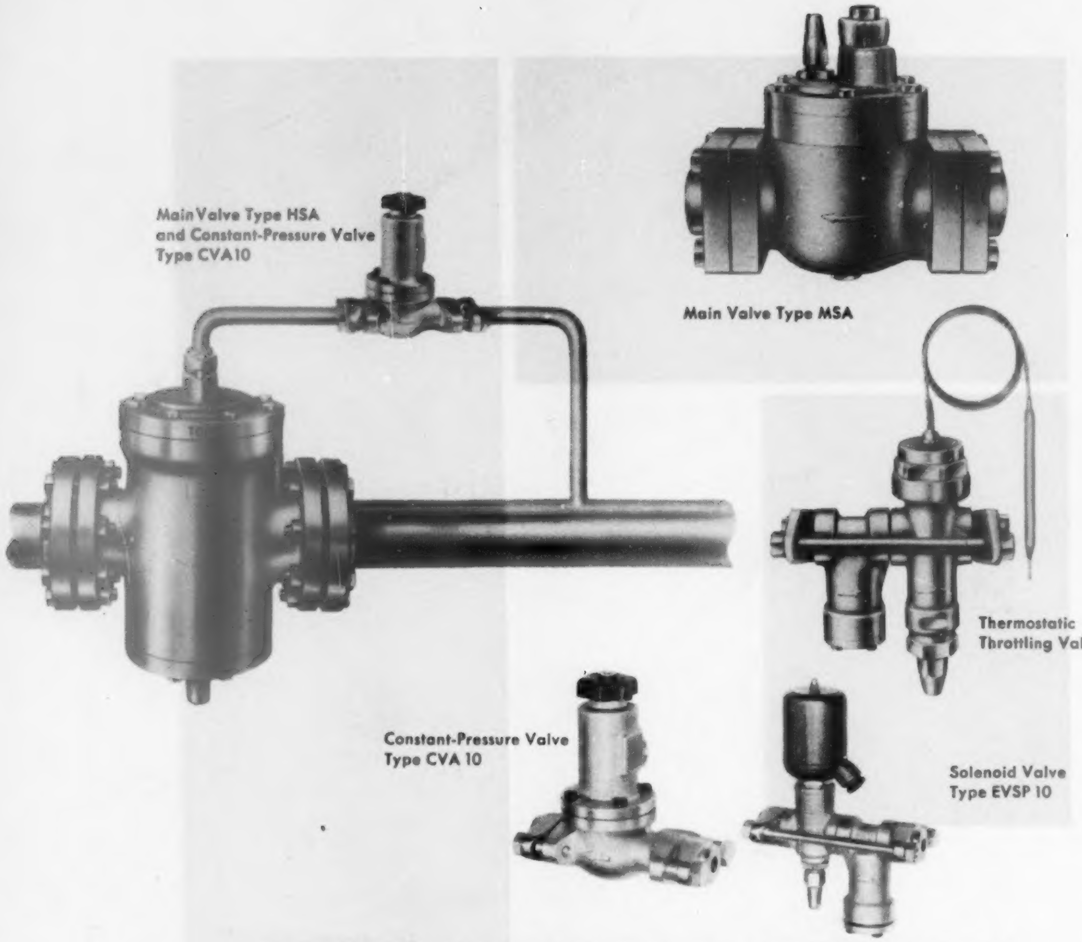
This ammonia storage sphere belonging to Fisons Limited is believed to be the largest of its kind in the world. Under its 3-inch layer of low vapour transmission Onazote it keeps 2,000 tons of ammonia at 32°F. The thermal insulation was undertaken by Onazote Insulation Company. They have unequalled experience in keeping temperatures low—down to −258°F. in the case of liquid methane. The refrigeration plant for this project was supplied by L. Sterne & Co.

Onazote Insulation Company Ltd

A subsidiary of Expanded Rubber Company Ltd.

Mitcham Road · Croydon · Surrey · Thornton Heath 3622

TA/2837



DANFOSS SERVO-OPERATED BACK-PRESSURE REGULATORS

. . . . . are always made in two parts in order to make them as universal as possible—a main valve and a pilot valve, ,the latter being inserted in an equalising line between the suction line from the evaporator and the top of the main valve.

As the main valve may be governed simultaneously by several pilot valves mounted in the same pressure equalising line, the combination can simultaneously control:

Constant evaporating temperature,
Constant air temperature,
Constant brine temperature.

if the pilot valve used is of the Type EVSP the main valve will act as a solenoid valve.

Danfoss

everything under Danfoss control

AUTOMATIC CONTROLS AND EQUIPMENT

NORDBORG . DENMARK

Printed in England for the Proprietors, Refrigeration Press Limited, Maclaren House, Great Suffolk Street London, S.E.1, by H. R. Grubb Ltd., Croydon. Registered for transmission to Canada, including Newfoundland.